SERIAL NO. CIV. ENG. 19-016-62-38

HURRICANE PROTECTION PROJECT

PAWCATUCK

PAWCATUCK RIVER, CONNECTICUT

SPECIFICATIONS

FOR THE

CONSTRUCTION OF

LOCAL PROTECTION PROJECT

VOLUME 2

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.

FEBRUARY 1962

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15 February 1962

VOLUME II OF II

TECHNICAL PROVISIONS
(Sections 12 to 28)

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND

CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS

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BRICK MASONRY - PUMPING STATION
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SECTION 12

BRICK MASONRY - PUMPING STATION

12-01. SCOPE. - This section covers brick masonry, complete, for the Pumping Station.

12-02. APPLICABLE PUBLICATIONS. - The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto.

a. Federal Specifications. -

QQ-S-632	Steel Bar, Reinforcing, (for) Concrete.
QQ-W-461e	Wire, Steel, Carbon, (Round, Bare and Coated).

b. American Society for Testing Materials Standards. -

A 153-60	Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
C 33-59	Concrete Aggregates.
C 62-58 & Tentative Rev. 1960	Building Brick (Solid Masonry Units Made from Clay or Shale).
C 67-60	Sampling and Testing Brick.
C 90-59	Hollow Load-Bearing Concrete Masonry Units.
C 126-60T	Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.
C 216-60	Facing Brick (Solid Masonry Units Made from Clay or Shale), including Tentative Revision, 1959 Supplement.
C 266-58T	Time of Setting of Hydraulic Cement by Gilmore Needles.
C 270-59T	Mortar for Unit Masonry.
C 426-58T	Drying Shrinkage of Concrete Block.
C 427-58T	Test for Moisture Condition of Hardened Concrete by the Relative Humidity Method.

12-03. MATERIALS. - a. Anchors and Ties. - Anchors and ties shall be of approved design and shall be zinc-coated ferrous metal of the types noted below. Zinc coating of anchors and ties shall conform to ASTM Standard A 153, class B-1, B-2, or B-3, as required. Dowels for copings shall be 1/2-inch brass pipe (Iron Pipe Size) of lengths required.

b. Brick. - Brick shall be common clay or shale brick conforming to ASTM Standard C 62, except brick for interior and exterior facings shall conform to ASTM Standard C 216, type FBS, selected for color range of approved samples. Brick shall be Grade SW. Facing brick shall be delivered to the job stacked, and the stacks shall be stored off the ground and shall be covered with weatherproof covers.

c. Precast Concrete (Cast Stone) Trim. - Precast concrete (cast stone) trim, including sills, copings, belt course, and door trim, unless otherwise shown, shall consist of a concrete having a minimum compressive strength of 3000 p.s.i. at 28 days using 1/2-inch to No. 4 nominal-size coarse aggregate reinforced with not less than two No. 4 bars. Precast units shall have beds and joints at right angles to the face, with sharp true arrises, and shall have drip grooves on underside where units overhang the walls. Copings and sills shall be cast with washes, and where overhanging the walls shall have drips cut on the underside. Copings shall be provided with socket joints. Trim shall be sound, free from fractures, cracks, blisters, and warping. Sills and copings shall be of proper width to overhang masonry as indicated. Shapes required for external and internal angles shall be furnished. The ends, except a 3/4-inch-wide margin at exposed surfaces, shall be roughened for bond. Precast-trim items shall have an absorption of not more than 8 percent by weight after immersion in water for 48 hours. Unless precast-trim items have been subjected during manufacture to saturated-steam pressure of 120 pounds or more per square inch for 5 hours or more, the trim items shall, after casting, be damp-cured for 24 hours or more, or steam-treated and shall then be aged under cover for 28 days or longer. Prior to use, each item shall be wetted and inspected for crazing. Evidence of excessive crazing will be cause for rejection. Cast-concrete members weighing over 80 pounds shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring.

d. Mortar. - (1) Mortar for all masonry shall comply with the property specification for type N mortar as set forth in ASTM Standard C 270 except that when tested for water retention, the mortar shall have a flow, after suction, of 75 percent or more when mixed to an initial flow of 125 to 140 percent. When tested for compressive strength, the water-retention requirements for mortar stipulated in ASTM Standard C 270 shall apply. When used in the work, mortar shall be mixed in the laboratory-established proportions with as much water as may be necessary to produce the workability desired regardless of initial flow. The contractor shall furnish a certified copy of laboratory-established proportions and tests as evidence that the mortar used in the work meets the requirements of the property specification as modified herein. No change in the laboratory-

established proportions shall be made nor shall materials with different physical or chemical characteristics be utilized in mortar used in the work unless the contractor furnishes additional evidence that such mortar meets the requirements of the property specification as specified herein.

12-04. HANDLING AND STORAGE. - Masonry materials shall be stored in an approved manner that will protect them from contact with soil and exposure to the elements.

12-05. SAMPLES. - The following samples of materials proposed for use shall be submitted to the Contracting Officer for his approval thereof received before material represented by the samples are delivered to the project site. Representative samples shall be taken periodically from on-the-site stockpiles as required by the Contracting Officer for testing.

a. Anchors and Ties. - Two of each type proposed for use.

b. Brick. - All shapes, sizes, and kinds in sufficient numbers to perform the required tests to show full range of color and texture.

c. Sample Panels. - After samples are approved, sample panels of each type of masonry wall construction required by the contract shall be erected on the project site where directed. Sample panels shall be 6 feet long by 4 feet high by the thickness of wall, showing proposed color range, texture, bond, and mortar joint.

12-06. CERTIFICATES. - The contractor shall furnish certificates executed in sextuplicate prior to delivery of the certified material to the project site. Each certificate shall be signed by an authorized officer of the manufacturing company and shall contain the name and address of the contractor, the project location, and the quantity and date or dates of shipment or delivery of the material to which the certificate applies. Brick shall be certified for compliance with all specification requirements.

12-07. TEST FOR MORTAR. - Test for mortar and to establish the proportions of the mortar to be used on the work shall be done by an approved commercial testing laboratory at the expense of the contractor.

12-08. ERECTION. - a. General. - Masonry shall not be erected when the ambient temperature is below 35 degrees F., except as otherwise specified below. No frozen work shall be built upon. No brick or other unit having a film of water or frost on its surface shall be laid in the walls. Masonry shall be protected from freezing for 48 hours after being laid. Masonry erected during arid weather when the ambient air has a temperature of more than 99 degrees F., in the shade and a relative humidity of less than 50 percent shall be protected from direct exposure to wind and sun for 48 hours after installation. Masonry shall be laid plumb, true to line, with level courses accurately spaced with a story pole, and, as otherwise specified, with each course

breaking joints with the course next below and with header course, each side of walls, every sixth course as shown. Each unit shall be adjusted to its final position in the wall while mortar is still soft and plastic. Any unit that is disturbed after mortar has stiffened shall be removed and relaid with fresh mortar. Bond pattern shall be kept plumb throughout. Corners and reveals shall be plumb and true. Courses shall be so spaced that backing masonry will level off flush with the face work at all joints. Anchors and ties shall be provided where required. Chases and raked-out joints shall be kept free from mortar or other debris. Spaces around metal door frames and other built-in items shall be solidly filled with mortar.

Anchors, wall plugs, accessories, flashings, and other items required to be built in with masonry shall be built in as the masonry work progresses. Cutting and fitting of masonry required to accommodate the work of others shall be done by masonry mechanics with masonry saws. The sizes of any two adjacent units shall be within permitted tolerances so that the difference between the vertical faces of such units shall not exceed 1/8 inch. Units shall be free from chipped edges or other imperfections detracting from the appearance of the finished work.

b. Cold-Weather Installation. - When masonry work is authorized during temperatures below 35 degrees F., special protective provisions as follows shall be provided.

(1) When the outside air temperature is between 35 degrees F. and 32 degrees F., all masonry units shall be kept completely covered and free from ice and snow at all times. Either the mixing water or sand for mortar shall be heated to a temperature between 70 degrees F. and 160 degrees F. The air temperature on both sides of the masonry shall be maintained above 40 degrees F. for a period of at least 72 hours. The contractor shall submit for approval a written statement of the methods he proposes to use for protecting the masonry against low temperatures. Building upon frozen work is prohibited.

(2) When the outside air temperature is between 32 degrees F. and 25 degrees F., in addition to the above provisions, both the mixing water and sand shall be heated to a temperature between 70 degrees F. and 160 degrees F.

(3) When the outside air temperature is between 25 degrees F. and 18 degrees F., in addition to the above provisions, calcium chloride shall be added to the mixing water at a rate not to exceed 1-1/2 to 2 pounds per sack of portland cement. Calcium chloride shall not exceed 1 percent for masonry cement mortars unless specifically recommended by the manufacturer of the masonry cement.

(4) When the outside air temperature is between 18 degrees F. and 0 degrees F., in addition to the above provisions, all masonry units when laid shall be heated to at least 40 degrees F.

(5) When the outside air temperature is 0 degrees F. and below, masonry work shall be performed only in emergency construction. In addition to the above provisions, all masonry units shall be heated to a temperature of at least 40 degrees F. Complete temporary inclosures shall be provided for masonry construction during sustained subzero weather.

c. Joints. - Joints, except joints to be calked, shall be tooled slightly concave with a device of as long length as practicable and so that the mortar will be thoroughly compacted and pressed against the edges of the units. Tooling shall not be done until after the mortar has taken its initial set. The following joints on the weather side of exterior masonry walls shall be raked out 3/4 inch and left ready for calking:

(1) Joints between metal frames and masonry.

(2) Other joints where so indicated.

d. Unfinished Work. - Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. All loose mortar shall be removed and the exposed joint shall be thoroughly cleaned before laying new work. Surfaces of masonry not being worked on shall be properly protected at all times during construction operations. When rain or snow is imminent and the work is discontinued, the tops of exposed masonry walls shall be covered with a strong waterproof membrane well secured in place. Adequate provisions shall be made during construction to prevent damage by wind.

e. Mortar. - Mortar that has stiffened because of chemical reaction due to hydration shall not be used. Except as specified below, mortar shall be used and placed in final position within 2-1/2 hours after mixing where air temperature is 80 degrees F. or higher, and within 3-1/2 hours after mixing where air temperature is less than 80 degrees F. Mortar not used within these time intervals shall be discarded. When cement or cements used in the mortar have been tested and the observed time of initial set as determined under ASTM Standard C 266 has been ascertained, the time interval during which the mortar must be placed in final position may be determined by an optional method as follows:

Air temperature in degrees F.	Time interval after mixing
80 or higher	Time of initial set minus 1 hour.
less than 80	Time of initial set minus 1/2 hour.

In mixing mortar, the maximum amount of water shall be used as necessary to produce the wettest workable consistency possible. Mortars that have

stiffened within the time interval as determined above, because of evaporation of moisture from the mortar, shall be retempered by adding water as frequently as needed to restore the specified consistency.

f. Brick. - Before being laid, brick shall be wetted so as to have an initial rate of absorption of not more than 0.025 ounce per minute per square inch of bed surface, determined in accordance with ASTM Standard C 67. Recessed brick shall be laid with the frog side down. Horizontal and vertical joints shall be completely filled with mortar when laid. Vertical joints shall be of the same width except for inconspicuous variations required to maintain the bond.

(1) Brick facing shall be laid up with the better face of the brick exposed. Shelf angles shall be adjusted as required to keep the masonry joints level and at the proper elevation.

(2) Joints. - Exposed mortar head and bed joints shall have a thickness equal to the difference between the actual and nominal dimensions of the brick in either height or length, but in no case shall the average width of any three adjacent joints be less than 1/4 or more than 1/2 inch.

(3) Back Parging. - Parging shall be not less than 1/2 inch thick. The space between the exterior face brick and the back-up brick and between the back-up brick and the interior face brick shall be parged as the wall is being built. The parging shall completely fill the space between the bricks.

g. Sills and Copings. - Sills, copings, and other precast trim shall be set with faces plumb and true, in a full bed of mortar, filling all anchor holes. Bed, horizontal and vertical joints shall be 1/4-inch thick, unless otherwise required or indicated. Sills and other precast items shall be leveled and tapped in place on these beds. Upon completion of the walls joints shall be raked out 3/4-inch back of the precast items and the joints pointed and tooled.

12-09. POINTING AND CLEANING. - Before completion of the work, all defects in joints of exposed exterior masonry surfaces shall be raked out as necessary, filled with mortar, and retooled. After pointing mortar has set and hardened, all exposed clay-brick masonry surfaces shall be wetted and then cleaned with a solution of 10 percent by volume of commercial muriatic acid applied with stiff-fiber brushes, and immediately after cleaning, the surfaces shall be thoroughly rinsed down with clear water. All masonry surfaces shall be left clean, free of mortar daubs, and with tight mortar joints throughout.

12-10. WATERPROOFING BRICK. - On completion of the structure the brick masonry shall be treated with a clear, colorless, silicone water repellant containing no fillers. The material shall leave no film on the surface of the brick masonry after it is applied. It shall be spray

applied to a point of refusal under low pressure. The material shall be Daracone as manufactured by Dewey and Almy Chemical Division, W. R. Grace and Co., or approved equal. The material shall be tested and submitted for approval by the contractor for compliance to the manufacturer's testing procedures.

12-11. PAYMENT. - No separate payment will be made for the work covered under this section, and all costs in connection therewith shall be included in the lump-sum contract price for the pumping station.

SECTION 13

SHEET METALWORK, GENERAL
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SECTION 13

SHEET METALWORK, GENERAL

13-01. SCOPE. - This section covers all sheet metalwork, complete for Pumping Station.

13-02. GENERAL. - Surfaces that are to receive sheet metal and underlayments shall be even, smooth, sound, thoroughly clean and dry, and free from defects that might affect the application. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed. Accessories and other items essential to complete the sheet metal installation, though not specifically indicated or specified, shall be provided. Where sheet metal abuts or members into adjacent materials, the juncture shall be executed in a manner to assure waterproof construction. Sheet metal items shall be fabricated and installed in accordance with the details indicated and as specified. Installation of items not shown in detail or not covered by detailed specifications shall be as set forth in the Sheet Metal Construction and Specifications publication of the Sheet Metal and Air Conditioning Contractors National Association, Inc. Wire gage for copper wire shall be Brown and Sharpe. All sheet metal work shall be 16 ounce copper unless otherwise specified or indicated.

13-03. MATERIALS. - Materials shall conform to the respective specifications and other requirements specified below.

a. Asphalt Primer. - Federal Specification SS-A-701.

b. Asphalt Roof Coating. - Federal Specification SS-R-00451a.

c. Copper. - Federal Specification QQ-C-576a, Sheet copper shall be light cold-rolled temper.

d. Fastenings. - Fastenings not specified for a particular sheet metal application shall be of the type best suited for the intended purpose. Nails, rivets, and screws for copper shall be bronze, copper, or copper clad. Thickness of copper cladding shall be not less than 10 percent of the diameter of the item.

e. Plastic Cement. - Federal Specification SS-C-153, type I.

f. Solder. - Solder shall conform to Federal Specification QQ-S-571, composition Sn50 for copper.

g. Soldering Flux. - Soldering flux not otherwise specified shall be rosin.

13-04. MINIMUM WEIGHT. -

Table I

Item designation	Copper, ounces per square foot
Downspouts	16
Basket strainers	Wire Ga. No. 9
Downspout straps, 2-inch width	20
Downspout heads	16
Scupper lining	24
Flashings	
Base	20
Cap	16
Through-wall	16
Sill	16
Gravel stops	16

13-05. PROTECTION OF COPPER. - Portions of copper that will be in contact with built-up roofing and portions of ferrous metal that will be in contact with copper shall be given a coat of asphalt varnish prior to application of the copper item.

13-06. SOLDERING, WELDING, AND SEAMING. - a. Soldering and Welding. - Edges of sheet metal shall be pretinned before soldering is begun. Soldering shall be done slowly with well-heated coppers so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Soldering shall follow immediately after application of the flux. Upon completion of soldering, the acid shall be neutralized and the surfaces shall be thoroughly cleaned.

b. Seams. - Seams shall conform to the following requirements. -

(1) Flat-lock seams shall finish not less than 3/4 inch wide.

(2) Soldered-lap seams shall finish not less than 1 inch wide.

(3) Unsoldered plain-lap seams shall lap not less than 4 inches unless otherwise specified.

(4) Flat seams shall be made in the direction of the flow.

13-07. SAMPLES AND CERTIFICATES. - a. Samples of Materials. - Samples of materials proposed for use shall be submitted to the Contracting Officer for approval on request. Sufficient samples shall be provided for check testing by the Government as required.

b. Certificates of Compliance. - Certificates of compliance with specification requirements shall be submitted in triplicate, when directed, in lieu of samples or in addition to samples. Each certificate shall be signed by an authorized officer of the manufacturing company, shall contain the name and address of the contractor, and shall contain the name and location of the project.

13-08. SHOP DRAWINGS. - Shop drawings and catalog cuts showing complete erection layouts, details, and installation instructions shall be submitted for approval in accordance with the SPECIAL CONDITIONS. Materials shall not be delivered to the site until after the approved shop drawings have been returned to the contractor. Details and layouts shall show weights, gages, or thicknesses of sheet metal, joining, expansion-joint spacing, and procedures to be followed during installation. The contractor shall be responsible for errors of detailing and fabrication and for the correct fitting of sheet metalwork shown on the shop drawings.

13-09. HANDLING AND STORAGE. - Sheet metal items shall be carefully handled to prevent damage to the surfaces, edges, and ends, and shall be stored at the site above the ground in a covered, dry location. Damaged items that cannot be restored to like-new condition will be rejected and shall be replaced at no additional cost to the Government.

13-10. DOWNSPOUT. - Downspout shall be of the rectangular type, size as indicated. Downspouts shall be factory corrugated longitudinally and shall be provided in one section. Downspout shall be set plumb and clear of the wall and shall be firmly secured to the supporting construction by 2-inch-wide straps attached to or made integrally with the downspout. Two straps shall be provided for downspout and located near the top and bottom. The strap at the top shall be fixed. The strap at the bottom of the section shall be slotted to permit not less than 1/2-inch movement of downspout. Elbow shall be provided where indicated.

a. Downspout Head. - Downspout head for scupper shall be style as shown and shall be closed at the top with removable wire bird screen that is securely attached to the head.

b. Scupper. - The interior of the scupper opening shall be completely lined with 24-ounce sheet metal. The scupper shall extend through the wall and empty into downspout head. The metal lining shall be a little smaller than the opening to allow for expansion and contraction in the connecting metal work. The top and sides of a 3/4-inch high gravel stop ridge shall be provided at the scupper inlet. Surfaces to receive the lining shall be coated with plastic cement.

13-11. EXPANSION JOINTS. - a. Expansion and Contraction Joints. - The number of expansion and contraction joints required for the sheet metal shall be specified below. One joint shall be provided at the

center of each run. Joints shall be evenly spaced. Expansion and contraction joints shall be slip type, loose locked, and fabricated in strict accordance with the metal producer's recommended practice.

13-12. FLASHINGS. - Flashings shall be installed at intersections of roofs with vertical surfaces, at projections through roofs and elsewhere as shown or specified and as required to provide watertight protection. Edges of flashings concealed in masonry joints shall be turned up 1/4 inch to form a water dam, and exposed edges of flashings shall be folded back 1/2 inch. Cap flashings shall be provided over metal or plastic base flashings.

a. Base Flashing. - Base flashing shall extend up vertical surfaces not less than 8 inches and out on the roof or horizontal surface or beyond cant strip not less than 4 inches. Straight runs of base flashing shall be made up in units of lengths conforming to the spacing of expansion joints specified in paragraph: Expansion and Contraction Joints and shall be joined together with a 3-inch loose-locked slip-type expansion joint filled with plastic cement. Intermediate joints located between expansion joints shall have locked and soldered seams. Installation of base flashing for built-up roofing shall be coordinated with roofing work. Base flashing shall be installed over the built-up roofing felts that have been placed over the cant strips. Base flashings shall be covered with two plies of felt with the top ply overlapping the ply beneath by not less than 2 inches. Both plies shall be mopped in place with hot bituminous material. Felt and bituminous material shall be of the same type and grade as that used for built-up roofing.

b. Cap Flashing. - Cap flashing shall be installed as shown and shall lap over base flashing not less than 6 inches, except where felt base flashing terminates under the cap flashing, the cap flashing shall be extended down close to the top of the cant strip to protect the base flashing.

c. Through-Wall Flashing. - Through-wall flashing includes all flashing that extends from the exterior face to the interior or backface of the exterior wall. The flashing shall be laid with a layer of mortar above and below the flashing so that the total thickness of the two layers of the mortar and flashing are of the same thickness as the regular mortar joints. Flashing shall terminate 1/2 inch from exterior face of wall.

d. Sill Flashing. - Sill flashing shall be of the mechanically keyed metal type. The sill flashing shall extend the full depth of the sill and not less than 4 inches beyond ends of sill. The back edge of the flashing shall terminate 1/2 inch from the interior face of the wall.

13-13. PAYMENT. - No separate payment will be made for the work covered under this section, and all costs in connection therewith shall be included in the lump-sum contract price for the Pumping Station.

SECTION 14

ROOFING: BUILT-UP
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SECTION 14

ROOFING: BUILT-UP

14-01. SCOPE. - This section covers built-up roofing, complete, for the pumping station.

14-02. GENERAL. - Asphalt or tar built-up roofing shall be applied to the roof surfaces indicated on the drawings. Plastic-type flashings, installed in accordance with this specification shall be used throughout except where otherwise specified or indicated on the drawings. Metal flashing shall conform to Section SHEET METALWORK, GENERAL. Asphalt shall be used with asphalt-saturated felts, and coal-tar pitch shall be used with coal-tar-saturated felts except that asphalt-saturated-felt flashings may be used in conjunction with coal-tar-pitch roofs.

14-03. MATERIALS. - The following materials shall conform respectively to the specifications and other requirements specified below:

a. Asphalt shall conform to the following tabulated specification:

Asphalt Characteristics	Test Method	Type A		Type B	
		Min.	Max.	Min.	Max.
Softening point (R&B), of	A.S.T.M. D36	135	148	135	148
Ductility at 77°F, 5 cm/min., cm.	A.S.T.M. D113	12		100	
Ductility at 40°F, 0.25 cm/min., cm.		3		--	
Penetration at 32°F, 200 g, 60 sec.	A.S.T.M. D5	10		5	
77°F, 100 g, 5 sec.		25	60	15	25
115°F, 50 g, 5 sec.		100		90	
Weight Loss, 5 hrs. at 325°F, %	A.S.T.M. D6		0.5		0.5
Penetration of residue at 77°F, percent of original		85		75	
Bitumen soluble in CCl4, %	A.S.T.M. D165	99		99	
Bitumen soluble in n-pentant, %	N.B.S. RP-2577		30		30
Flow test at 120°F, 5 hrs., cm.	A.S.T.M. D1191 Modified	1	9	2	9

Asphalt Characteristics	Test Method	Type A Min.	Type A Max.	Type B Min.	Type B Max.
	1. Aluminum panel (6" x 2-3/4" x 0.064") 2. 45° ∠ 1° inclination 3. 120°F ∠ 2°				
Spot test	A.A.S.H.O. T102	Negative		Negative	
Susceptibility factor	Pen at 115°F - Pen. at 32° -F	2		5	
Flash point, C.O.C., °F	A.S.T.M. D92	425		425	

b. Asphalt primer. - Federal Specification SS-A-701

c. Coal-tar pitch. - Federal Specification R-P-381, type I.

d. Felt shall be either the asphalt-saturated or the coal-tar-saturated type and shall conform to the following requirements:

(1) Asphalt-saturated felt: Federal Specification HH-F-191a, type I, No. 15.

(2) Coal-tar-saturated felt: Federal Specification HH-F-201, type I, No. 15.

e. Cant strips. Cellular glass or preservative treated wood.

f. Mineral-surfaced roofing: Federal Specification SS-R-630 Class 1.

g. Plastic bituminous cement: Federal Specification SS-C-153, type I with asphalt-saturated felts and type II with coal-tar-saturated felts.

h. Surfacing Materials. -Surfacing materials shall consist of screened and washed gravel. Aggregates shall be hard, dry, opaque, and free from elongated, flat and sharp-edged particles, dirt, clay, loam, adherent coatings and any other material or foreign substances that would affect performance and bond or cause deterioration or staining of any metal with which they would come in contact.

Grading of the aggregate at time of application shall conform to the following requirements:

Sieve Size (U. S. Standard)	Percent Passing by Weight
3/4-inch	100
5/8-inch	95-100
1/4-inch	0-50
No. 6	0-5

In addition, not more than 0.5 percent, by weight, of the total sample tested, shall pass a No. 200 sieve when tested in accordance with ASTM Method C117.

14-04. PREPARATION OF SURFACES. - The entire roofdeck construction shall be completed before roofing work is begun thereon. Roofing shall not start until roofdeck surfaces are smooth, firm, dry, and free from dirt and foreign materials, and have been inspected and approved by the Contracting Officer. Projections through roofs shall be prepared properly for flashing and secured in position.

14-05. APPLICATION OF ROOFING. - a. General. - Asphalt shall not be heated above 450°F., and coal-tar pitch shall not be heated above 400°F. Rolls of felt shall be stacked in properly protected piles and maintained at a temperature of not lower than 50°F. for not less than 24 hours prior to laying. Felt and surfacing material shall be dry when applied, and in addition the surfacing material shall be heated in cold weather. The ambient temperature shall be at least 40°F. and rising. Asphalt and coal-tar pitch shall be hot when applied, and layers of felt shall be laid immediately behind the mop and shall be free of wrinkles or buckles. As each course of felt is mopped into hot bitumen, the surface of the felts shall be carefully broomed-in with an 18- or 20-inch-wide soft-fiber-type floor broom sufficiently to obtain complete adhesion between plies and to close out any air pockets. It is not permissible to mop half the width of sheet and turn back the other half and mop under that portion. Workmen shall not walk on mopped surfaces when the bitumen is in a sticky condition. Either coal-tar or asphalt products may be used at the option of the contractor. Each layer of roofing felt shall be carried up to top of cant strip. Where scupper is indicated, 5-ply built-up roofing, without surfacing, shall be installed to out face of building.

(1) Lapping felts. - Felts shall be laid with not less than the following laps:

Table I - Laps for Roofing Felts

Layers or plies	Laps in inches for 36-inch felt	Starting widths in inches for 36-inch felt
5	29	8, 15, 22, 29, and 36

End laps of roofing felts shall be 6 inches.

b. Standard roofing specifications. - The following standard specifications establish the minimum requirement for the construction and application of bituminous slag- or gravel-surfaced, built-up roofing:

(1) Type 5ACS, slag- or gravel-surfaced, asphalt, built-up, 5-ply roofing on concrete surfaces: The built-up roofing shall consist of not less than the following quantities, in pounds, for each 100 square feet of roof surface:

Asphalt primer	10
5 layers of asphalt-saturated rag felt	75
Asphalt -	195
Roofing gravel	400

The concrete roof surface shall be coated with asphalt primer, using not less than 10 pounds per 100 square feet. Over the asphalt primer, when dry, channel or spot mopping shall be applied at the rate of not less than 15 pounds per 100 square feet. Channel mopping shall be done in one direction with approximately 6-inch spacing between strips, leaving ends open. Spots in spot mopping shall be spaced uniformly, permitting no closed pockets between. Five layers of asphalt-saturated felt shall be rolled-in immediately after the hot mopping, over the entire roof surface, and lapped in accordance with table I. Each sheet of asphalt-saturated felt shall be mopped-in the full width of the lap with hot asphalt, using not less than 30 pounds per 100 square feet for each mopping. Flashing shall be installed and surfacing shall be applied as specified.

(2) Type 5TCS, slag- or gravel-surfaced, tar, 5-ply roofing on concrete surfaces: The built-up roofing shall consist of not less than the following quantities, in pounds, for each 100 square feet of roof surface:

5 layers of coal-tar saturated rag felt	75
Coal-tar pitch	225
Roofing gravel	400

The concrete roof surface shall be given a uniform coating of hot coal-tar pitch, using not less than 50 pounds on concrete per 100 square feet. Five layers of coal-tar-saturated felt shall be rolled-in

immediately after the hot-mopping, over the entire roof surface, and lapped in accordance with table I. Each sheet of coal-tar-saturated felt shall be mopped-in the full width of the lap with hot coal-tar pitch, using not less than 25 pounds per 100 square feet for each mopping. Flashing shall be installed and surfacing shall be applied as specified.

(3) Option. - Fiber-glass mats, resinous-bound and asphalt-loaded, laid in the same number of plies as specified for asphalt-saturated-felt built-up roofs and in accordance with respective specification may be applied as an option, provided; (1) The first ply or base sheet shall be made of glass fibers specially reinforced with random-oriented continuous glass yarn and saturated or loaded with not less than 12 pounds of asphalt per 100 square feet. Over concrete deck one ply base sheet shall be spot-mopped to deck using 12-inch spots on 24-inch centers longitudinally in three rows per width of sheet staggered at the rate of 15 pounds per 100 square feet. (2) The ply sheets shall be made of glass fibers specially reinforced with random-oriented continuous glass yarn loaded with an average of 6 pounds of asphalt per 100 square feet.

c. Flashings. - Flashings shall be provided in the angles formed at cants and where required to make the work watertight. Except where metal base flashings are required, indicated or specified, built-up flashings shall be provided and shall be installed before the top pouring and surfacing aggregate are applied to the roofing.

(1) Built-up base flashings where indicated shall consist of four layers for five-ply roofing, of No. 15 saturated rag felt and one layer of SS-R-630 mineral-surfaced roofing cemented together with plastic roofing cement. When asphalt materials are used, masonry over which flashing is to be installed shall be primed with asphalt primer and allowed to dry thoroughly. The four layers of saturated felt and the mineral-surfaced roofing shall be evenly bedded in bituminous plastic cement applied with a trowel, using not less than 50 pounds per 100 square feet per sheet. The first layer of felt shall extend out onto the roofing at least 2 inches, and each succeeding layer shall extend at least 2 inches beyond the preceding layer. Flashing sheets shall be approximately 5 feet in length and shall be lapped not less than 6 inches with laps staggered in each layer. Mineral-surfaced roofing strips shall be cut from the width of the material and laps shall be made with selvage well cemented.

(2) Metal base flashings, cap or counter flashings and gravel stop are specified under SECTION SHEET METALWORK, GENERAL.

d. Surfacing. - After roofing felts have been laid and flashing is installed, the entire roof surface, except cants, shall be coated uniformly with hot asphalt or hot pitch poured on at the rate of not less than 60 pounds and 75 pounds per 100 square feet for asphalt or pitch respectively. While bitumen is still hot, the surfacing aggregate material, in the quantity hereinbefore specified, shall be evenly bedded therein.

14-06. PAYMENT. - No separate payment will be made for the work covered under this section of the specifications, and all costs in connection therewith shall be included in the applicable lump-sum contract price for the pumping station.

SECTION 15

METAL DOORS
(INDEX)

SECTION 15

METAL DOORS

15-01. SCOPE. - This section covers metal doors, complete, for Pumping Station.

15-02. SHOP DRAWINGS. - Shop drawings shall be submitted for approval in accordance with the SPECIAL CONDITIONS, and approval received before delivery of doors. Drawings shall indicate details of construction; method of assembling sections; location and installation of hardware; size, shape, and thickness of materials; joints and connections.

15-03. SHOP FINISH. - Steel surfaces shall be thoroughly cleaned, and exposed surfaces shall be filled and ground smooth. All steel for doors shall be zinc-coated. The coating shall be applied by hot-dipping and shall conform to ASTM Standard A 386-59 except that the weight of coating shall be not less than 1.25 ounces per square foot of surface. Doors shall be given a phosphate treatment conforming to Federal Specification TT-C-490, Type I, and prime coated in accordance with the manufacturer's directions or cleaned and prepared as specified for galvanized surfaces in the PAINTING section and coated with a primer conforming to Federal Specification TT-P-641b, type II.

15-04. FIELD MEASUREMENTS. - The contractor shall verify all measurements at the building site and shall be responsible for dimensions, fitting, and the proper attachment of items directly connected with the door installation.

15-05. GENERAL REQUIREMENTS. - a. Metal. - Metal shall be cold-rolled, stretcher-leveled sheet steel of gages hereinafter specified and shall have clean smooth surfaces.

b. Workmanship. - The finished work shall be strong and rigid, neat in appearance, free from defects, warp, or buckle. Molded members shall be clean-cut, straight and true, with joints coped or mitered, well formed, and in true alinement. Exposed welded joints shall be dressed smooth.

c. Size and Thickness. - Doors shall be of design indicated, 1-3/4 inches thick. Door clearances shall be not more than the following: 3/32-inch at jambs and heads, and 3/16-inch at bottom.

d. Stile Edges. - The lock edges of stiles shall be beveled 1/8-inch in 2 inches. Doors shall have a metal T-type astragal applied on the active leaf, surface-mounted or recessed.

e. Provisions for Hardware. - Doors shall be mortised, reinforced, and drilled and tapped to receive template hinges, and locks. Surface-applied hardware for doors shall be provided with reinforcing only. Drilling and tapping shall be done in the field. Reinforcing plates shall be 11-gage for mortised hardware and 14-gage for surface-applied hardware.

f. Hardware. - The inactive leaf of the entrance door shall have 2 pair butts, one chain bolt, a foot bolt, and a door holder. The active leaf shall have 2 pair of butts, lock, and door closer, and door holder. Six keys shall be provided.

*Butts - 2 pair each leaf, Type T-2147 USP, 5" x 4-1/2" (non-rising, non-removable pins when doors are closed).

*Oilite bearing butts may be furnished at contractor's option.

Foot bolt, type 1021B modified for 8".
Chain bolt, type 1021A modified for 8".
Door closer, type 3001, size VI, with corner bracket.
Lock, type 123B-25.
2 door holders, type 1172, size A.

The above hardware shall conform to the applicable requirements of the following Federal Specifications:

FF-H-106a	Hardware, Builders; Locks and Door Trim.
FF-H-111a	Hardware, Builders; Shelf and Miscellaneous.
FF-H-116c	Hinges, Hardware, Builders.
FF-H-121c	Hardware, Builders; Door Closing Devices.

15-06. HOLLOW METAL DOORS, HINGED TYPE. - Flush doors shall be constructed of two outer sheets of 16-gage steel with edges welded and finished flush. The outer face sheets shall be reinforced with 20-gage interlocking vertical channels or Z- members spaced not over 6 inches apart and spot-welded to outer face sheets. Tops and bottoms of doors shall have continuous reinforcing channels welded to face sheets. Sound-insulation fillers of cork, fiberboard, mineral-wool board, or asbestos shall be placed full height in spaces between reinforcing channels. Tops and bottoms of doors shall have 16-gage continuous-channel closures welded to the face sheets. Metal moldings around glazed openings and louvers shall be 20-gage metal. At the contractor's option, a continuous-truss inner core of sheet metal not lighter than 28-gage may be substituted for the reinforcing specified above providing it is spot-welded to the face sheets every 2-3/4 inches horizontally and vertically over the entire surface of both sides.

15-07. PAYMENT. - No separate payment will be made for the work covered under this section, and all costs in connection therewith shall be included in the applicable lump-sum contract price for the Pumping Station.

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SECTION 16

ELECTRICAL WORK

SECTION 16

ELECTRICAL WORK

16-01. SCOPE. - This section covers electrical work complete, including service from existing building No. 2Y of the Yardney Corp.

16-02. APPLICABLE PUBLICATIONS. - The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

a. Federal Specifications.

W-C-586	Conduit Outlets (Cast-Iron, Malleable-Iron and Cast-Aluminum, with Covers and Accessories -- for Shore Use).
W-C-596	Connector, Plug, Electrical; Connector, Receptacle, Electrical; Plate, Wall, Electrical.
W-F-406a	Fittings for Electrical; Cable and Flexible Metal Conduit.
W-F-408a & Am-2	Fittings for Conduit, Metal, Rigid (Rigid Steel and Electrical Metallic Tubing).
W-L-101f	Lamps, Electric, Incandescent, Large, Tungsten-Filament.
W-L-142a	Lampholders (Sockets); Medium-Screw-Shell, General Service.
W-P-131a & Am-2	Panelboards; Equipped with Automatic Circuit-Breakers.
W-S-610	Splice, Conductor.
W-S-865c	Switch, Box, (Enclosed) Surface Mounted.
W-S-896a	Switches, Toggle, Single-Unit; with Wall Plates.
CC-M-636a & Am-2	Motors, Fractional Horsepower, (Alternating-Current).

TT-E-489b & Am-1	Enamel; Gloss, Synthetic (for Exterior and Interior Surfaces).
TT-P-636b	Primer Coating, Synthetic, Wood and Ferrous Metal.
WW-C-566a	Conduit, Steel, Flexible.
WW-C-581c & Am-2	Conduit, Steel, Rigid, Zinc-Coated.

b. Military Specifications. -

MIL-T-704C & Am-1	Treatment and Painting of Material.
MIL-I-7798A & Am-2	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic.

c. National Fire Protection Association Publication. -

No. 70	National Electrical Code (Current Issue).

d. National Electrical Manufacturers Association Standards. -

IC 1	Industrial Control (Current Issue).

e. Underwriters' Laboratories, Inc. Standards. -

Cabinets and Boxes (Current Issue).
Industrial Control Equipment (Current Issue.)
Service Equipment (Current Issue.)

16-03. GENERAL. - a. Rules. - The installation shall conform to the applicable rules of the National Electrical Code.

b. Coordination. - The contract drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The contractor shall study building plans and details so that the outlets and equipment will be properly located and readily accessible. Lighting fixtures, equipment, and outlets shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement. If any conflicts occur necessitating departures from the contract drawings, details of departures and reasons therefor shall be submitted as soon as practicable for written approval of the Contracting Officer.

c. Standard Products. - Materials and equipment submitted for approval shall be the standard cataloged products of concerns regularly engaged in the manufacture of the products and shall be the latest standard design that conforms to the specification requirements.

d. Materials and Equipment Schedules. - As soon as practicable and before starting installation of any materials or equipment, the contractor shall submit to the Contracting Officer for approval a complete list in six copies of materials and equipment proposed for installation. This list shall include manufacturers' names and material or equipment identification such as styles, types, or catalog numbers, to permit ready and complete identification.

e. Approval of Materials. - Approval of materials will be based on the manufacturer's published data. The label or listing of the Underwriters' Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the contractor shall submit a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements. A manufacturer's statement indicating complete compliance with the applicable Federal or Military specification, or the ASTM, NEMA, or other commercial standard is acceptable.

16-04. MATERIALS AND EQUIPMENT. - The following materials and equipment shall conform to the respective specifications and other requirements specified herein.

a. Cabinets. - Underwriters' Laboratories, Inc., Standard for Cabinets and Boxes.

b. Conduit. - (1) Flexible Steel Conduit. - Federal Specification WW-C-566.

(2) Zinc-coated rigid steel conduit. - Federal Specification WW-C-581.

c. Connectors, wire pressure. - Federal Specification W-S-610.

d. Fittings, Cable and Conduit. - Federal Specifications W-F-406 and W-F-408.

e. Lamps. - (1) Incandescent lamps, large. - Federal Specification W-L-101.

f. Motors. - (1) Fractional-horsepower motors, AC. - Federal Specifications CC-M-636.

g. Motor Controls. - NEMA Standard IC 1 and Underwriters' Laboratories, Inc., Standard for Industrial Control Equipment.

h. Outlets. - (1) Conduit, cast metal or malleable metal. - Federal Specification W-C-586.

i. Panelboards. - (1) Circuit-breaker-type panelboards. - Federal Specifications W-P-131. Circuit breakers shall conform to class A requirements. Two-single pole circuit breakers with handle tie or bail or equivalent construction are not acceptable for a double-pole breaker.

j. Receptacles. - Federal Specification W-C-596.

k. Service Equipment. - Federal Specification W-S-865, type ND and Underwriters' Laboratories, Inc., Standard for Service Equipment.

l. Sockets, medium-screw base. - Federal Specification W-L-1.

m. Splice, conductor. - Federal Specification W-S-610.

n. Switches. - (1) Enclosed safety switches. - Federal Specification W-S-865, type NDS as indicated.

(2) Snap switches, single-unit type. - Federal Specifications W-S-896.

o. Tape. - (1) Plastic tape. - Military Specification MIL-T-7798.

16-05. WORKMANSHIP. - All materials and equipment shall be installed in accordance with recommendations of the manufacturer as approved by the Contracting Officer, to conform with the contract documents. The installation shall be accomplished by workmen skilled in this type of work.

16-06. GROUNDING. - Except where specifically indicated otherwise, all exposed non-current-carrying metallic parts of electrical equipment, raceway systems, and neutral conductor of the wiring system shall be grounded. The ground connection shall be made at the main service equipment and shall be extended to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flange connection.

16-07. WIRING METHODS. - a. General. - Generally, unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated-steel conduit.

b. Conduit Systems. - Conduit systems shall be installed in accordance with article 346 of the National Electrical Code. Minimum size of raceways for branch circuit wiring shall be 3/4 inch. Raceways shall be concealed within finished walls, ceilings, and floors where possible and shall be kept 6 inches away from parallel runs of flues and steam or hot-water pipes. Raceways shall be supported and secured at intervals of not more than 8 feet. Exposed raceways shall have runs installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Raceways shall not be installed under the firepit of boilers and furnaces. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Clogged raceways shall be entirely freed of obstructions or shall be replaced. Conduits shall be fastened to all sheet-metal boxes and cabinets with two locknuts where required by the National Electrical Code, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing will be acceptable. Bushings shall be installed on the ends of all conduits and shall be of the insulating type where required by the National Electrical Code. Fittings installed in concrete shall be concrete-tight, and where installed in wet locations or exposed to the weather, fittings shall be raintight. Raceways crossing expansion joints in concrete slabs shall be provided with suitable expansion fittings. Raceways installed underground or under slabs on grade shall be coated with an asphaltic paint, plastic coating, or shall be wrapped with a pressure-sensitive plastic tape. Wooden plugs inserted in concrete or masonry are not acceptable as a base for raceway fastenings, nor shall raceways or pipe straps be welded to steel structures. Raceways shall be secured by pipe straps or shall be supported by wall brackets, strap hangers, or ceiling trapeze, fastened by expansion bolts on concrete. Nail-type nylon anchors or threaded studs, driven in by a powder charge and provided with lock washers and nuts, are acceptable in lieu of expansion bolts.

c. Insulated Wire and Cable. - (1) General. - (a) All wire and cable for power, control and lighting systems shall be single conductor cables, insulated as specified below with either a heat and moisture-resisting or an ozone-resisting grade of insulation and with heavy duty oil resistant thermosetting synthetic compound, Neoprene jackets, all conforming to the specific requirements specified below.

(b) The conductor size shall be #12 AWG except as indicated on the drawings.

(2) Materials, Construction, and Tests, unless otherwise specified, shall conform to the applicable requirements of the IPCEA-NEMA Standards Publication No. WC 3-1959, March 1959, entitled. "Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy". Parts, sections, appendices, grades and classes specified hereinafter will refer to the above IPCEA-NEMA standard, unless otherwise stated.

(3) Conductors shall be of tin or lead alloy coated annealed copper wire conforming to all the applicable requirements of Part 2. Conductors shall be solid or stranded as required below,

(a) Power Circuits. - (1) Conductors. - Conductors shall have Class B stranding.

(b) Lighting Circuits. - Conductors shall be solid.

(c) Control Circuit. - Conductors shall have Class B or Class C stranding and shall be not smaller than No. 12 AWG.

(4) Insulation. - (a) Material. - Conductor insulation shall be suitable for conductor temperature of not less than 75°C, and shall be either a vulcanized "synthetic rubber Heat and Moisture Resisting" grade of insulation or an "Ozone-Resisting Natural or Synthetic Rubber" grade of insulation. The "Ozone-Resisting" grade of insulating compounds shall conform to the requirements of Paragraphs 3.14 or 3.15, except that water absorption characteristics of the Ozone-Resisting Natural or Synthetic Rubber grade of insulation (3.14) shall be as follows:

The compound, after a 24-hour immersion, shall show a specific inductive capacity not greater than 4.5; and, after a continuous 14-day immersion, shall show a specific inductive capacity not more than 7 percent higher than the value determined at the end of the initial 24-hour period, nor more than 3 percent higher than at the end of the seventh day.

The "Synthetic Rubber, Heat and Moisture Resisting" grade of insulating shall conform to the requirements of Paragraph 3.13, except that the specific inductive capacity and mechanical water absorption characteristics shall be as follows:

The compound, after a 24-hour immersion, shall show a specific inductive capacity not greater than 5; and, after a continuous 14-day immersion, shall show a specific inductive capacity not more than 10 percent higher than the value determined at the end of the initial 24-hour period, nor more than 3 percent higher than at the end of the seventh day.

The compound, after a 7-day immersion, shall not absorb more than .015 grams of water per square inch of surface exposed to the water.

The manufacturer, shall perform tests on samples of the insulation taken from the finished product to determine compliance with the specified requirements. The test result of these shall be submitted to the Contracting Officer. Test procedure shall be in accordance with the applicable requirements of ASTM Standard D470-58T, entitled "Testing Rubber and Thermoplastic Insulated Wire and Cable."

(b) Insulation Thickness. - Thickness of conductor insulation shall be not less than that shown in Part 3, Table 12, Ungrounded neutral, for the respective Rated Circuit Voltages.

(5) Jackets. - Over the insulated conductor there shall be applied an outer jacket of an oil-resisting thermosetting synthetic compound conforming to Part 4, paragraph 4.13.3. The jacket shall be in direct contact and adhere to the conductor insulation. The jacket thickness shall be as specified in Part 4, Table 26.

(6) Dimensional Tolerance. - The outside diameter of single-conductor wires and cables and multiple-conductor cables shall not vary more than 10 percent and 5 percent, respectively, from the calculated outside diameter based on the thickness, including tolerance, of the component materials specified.

d. Conductor Identification of Branch Circuits. - Conductor identification of branch circuits shall be by color coding. Control circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved by the Contracting Officer. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved shop drawings. Hand lettering or marking is not acceptable.

16-08. OUTLETS. - Each outlet in the wiring or raceway systems shall be provided with an outlet box to suit the conditions encountered. Outlet boxes shall be of the cast-metal type having threaded hubs. Each box shall have sufficient volume to accommodate the number of conductors entering the box, in accordance with the requirements of the National Electrical Code. Boxes installed in concealed locations shall be set flush with the finished surfaces. Boxes shall be installed in a rigid and satisfactory manner and shall be supported by bar hangers in frame construction or shall be fastened directly with wood screws on

wood, with bolts and expansion shields on concrete and with machine screws or welded threaded studs on steelwork. Threaded studs driven in by a powder charge and provided with lockwashers and nuts are acceptable in lieu of screws, expansion shields, or machine screws.

a. Boxes for use with Conduit Systems. - Boxes for use with conduit systems shall not be less than 1-1/2 inches deep except where shallower boxes are required by structural conditions and are approved by the Contracting Officer. Switch and receptacle boxes shall be not less than 4 by 2 inches.

16-09. DEVICE PLATES of the one-piece type shall be provided for all outlets to suit the devices installed. Plates shall be of cast metal having rounded or beveled edges. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed vertically and with an alinement tolerance of 1/16 inch. The use of sectional-type device plates will not be permitted.

16-10. RECEPTACLES. - a. Duplex Receptacles shall be rated 15 amperes, 125 volts, two-pole, three-wire, grounded type with polarized parallel slots, style D series, in accordance with Federal Specification W-C-596. Bodies shall be of brown phenolic compound supported by mounting yoke having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal, or shall have pressure-type screwless terminals with suitable conductor release arrangement. The third grounding pole shall be connected to the metal mounting yoke.

16-11. WALL SWITCHES shall be of the totally enclosed tumbler type with bodies of phenolic compound. Handles shall be brown. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20-ampere, 277-volt for use on alternating current only.

16-12. SERVICE EQUIPMENT. - Service-disconnecting means shall be of the enclosed fusible type equipped with an external lever or handle for manual operation. Each unit shall be enclosed in a sheet-metal enclosure suitable for mounting as indicated. Surface-mounted enclosures shall have hinged doors and catches. Neutral connections shall be solid throughout.

16-13. PANELBOARDS shall be of the dead-front safety type provided with the size and number of single-, double-, or triple- pole branches as indicated. Mains shall be arranged for a grounded, solid-neutral system with lugs only in mains unless otherwise indicated.

a. Panelboards for lighting and power circuits shall be of the circuit-breaker type. Plug-in type breaker connections are not acceptable.

16-14. BATTERY CHARGER shall be of the automatic on-off rate type with a voltmeter, ammeter and rheostat. Battery charger shall be capable of delivering 1/2 of the 8 hour discharge rate of the battery. Charger shall be connected to 120 volt, A.C. power and to batteries. Batteries are provided under Paragraph 18-07k(2).

16-15. CABINETS. - Cabinet boxes shall be constructed of zinc-coated sheet steel.

a. Panelboard cabinets shall be provided with not less than 4 inch wiring-gutters at the sides, top, and bottom. Cabinet heights shall not exceed 78 inches. Cabinets shall be mounted so that the distance from the floor to the center of the top circuit breaker will not exceed 6 feet 6 inches. Trims shall be fitted with hinged doors having combination lock and latch. All locks shall be keyed alike. Each circuit shall have provisions for locking in the open and closed positions. A directory holder with clear plastic or glass plate and metal frame shall be mounted on the inside of each door or on each fused switch. A neatly typed directory properly identifying each circuit shall be mounted in the frame.

16-16. MOTORS furnished under this and other sections of these specifications shall be of sufficient size for the duty to be performed and shall not exceed the motors' full-rated load when the driven equipment is operating at specified capacity under the most severe conditions likely to be encountered. The horsepower ratings indicated on electrical plans are for guidance only and do not limit the equipment size. Unless otherwise specified, all motors shall have open frames, class A insulation, and continuous-duty classification based on a 40 degrees C ambient temperature of reference. Polyphase motors shall be type II, design B, squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified elsewhere. When electrically driven equipment furnished under other sections of these specifications materially differs from the contemplated design, the contractor shall make the necessary adjustments to the wiring, disconnect devices, and branch-circuit protection to accommodate the equipment actually installed.

16-17. MOTOR CONTROL. - Each motor or group of motors requiring a single control shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8 horsepower or larger shall be provided with thermal-overload protection. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually

reset type. Single- or double-pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for singl-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic-control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic control device does not have such a rating, a magnetic starter shall be used, with the automatic-contro device actuating the pilot-control circuit. When combination manual-and -automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selectro switche marked Manual-Off-Automatic. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any Manual-Off-Automatic switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings.

a. Contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA Standard IC 1-18.20 for Class B relays.

16-18. MOTOR-DISCONNECT MEANS. - Each motor shall be provided with a disconnecting means under this section of the specification, when required by the National Electrical Code even though not indicated. A circuit-breaker in a panelboard will be acceptable as a disconnecting means if located within sight of the motor controller. For single-phase motors, a single- or double-pole tumbler or snap switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 200 percent of the rating of the controlled equipment. Switches shall be horsepower-rated in conformance with table III of Federal Specification W-S-865. Switches shall disconnect all underground conductors.

16-19. LAMPS AND LIGHTING FIXTURES of types and sizes as indicated shall be furnished and installed complete.

a. Lamps of the proper type, wattage, and voltage rating shall be furnished and installed in each fixture.

(1) Incandescent lamps shall be for 120-volt operation unless otherwise specified.

(2) Lamps shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project.

b. Fixtures shall conform to the following specifications and shall be as detailed on drawing No. 40-06-04, sheets Nos. 10, and 11, which accompany and form a part of this specification. Illustrations shown on these sheets are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent light-distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved by the Contracting Officer.

(1) Accessories such as straps, mounting plates, nipples, or brackets shall br provided for proper installation.

16-20. EQUIPMENT CONNECTIONS. - All wiring for the connection of motors and control equipment as indicated on the electrical drawings shall be furnished and installed under this section of the specifications. Except as otherwise specifically noted, automatic-control wiring, signaling, and protective devices are not included in this section of the specifications but shall be furnished and installed under other sections of the specifications. Control wiring not shown on the electrical drawings shall be furnished under other sections of the specifications.

a. Flexible connections of short length shall be provided for all motors and equipment subject to vibration or movement. Liquid-tight flexible conduit shall be used in wet locations.

16-21. PAINTING AND FINISHING. - a. Factory-applied paint. - The enclosures for the following listed items shall be cleaned, primed, and painted inside and outside in accordance with Military Specification MIL-T-704.

Item	Finish Color
Safety switches	Manufacturer's
Panelboards	Manufacturer's
Motors	Manufacturer's
Motor Controls	ASA 49 - Grey

b. Field-applied prime coats. - All exposed ferrous-metal surfaces not specified to be factory painted shall be primed in accordance with SECTION: PAINTING.

c. Field finish painting is specified in SECTION: PAINTING.

16-22. REPAIR OF EXISTING WORK. - The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of new or existing floors, walls, partitions, ceilings, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to buildings, piping, or equipment shall be repaired by skilled mechanics of the trades involved, at no additional cost to the Government.

16-23. TESTS. - After the interior-wiring-system installation is completed, and at such time as the Contracting Officer may direct, the contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this specification. The test shall be performed in the presence of the Contracting Officer or an authorized representative. The contractor shall furnish all instruments and personnel required for the tests, and the Government will furnish the necessary electric power.

16-24. GUARANTY. - The following equipment to be furnished under this section of the specifications shall be guaranteed in accordance with the guarantee in the SPECIAL CONDITIONS:

Switches
Panelboards
Fixtures

16-25. PAYMENT. - No separate payment will be made for the work covered under this section, and all costs in connection therewith shall be included in the lump-sum contract price for the Pumping Station.

Revisions to Electrical Fixture Drawing No. 40-06-04

1. The following revisions will be incorporated in the specifications of the subject drawing pending revision of the sheets by the Chief of Engineers:

a. Sheet No. 3. - Add the following: "Reflector and socket shall be easily detached as a unit."

b. Sheets Nos. 5 and 7. - Add the following: "Fixture necks shall be provided with openings for ventilation."

c. Sheets Nos. 8 and 9. - Delete requirement for "threaded neck" construction; eighth line, delete "asbestos".

d. Sheet No. 10. - First line, delete "screw type"; third line, insert "bakelite or" before "porcelain"; fifth line, delete "asbestos".

e. Sheet No. 11. - First line, delete "screw type"; third line, insert "bakelite or" before "porcelain"; fifth line, delete "asbestos"; sixth line, delete the words "round or" and substitute "a".

f. Sheet No. 12. - Second line, delete "20 gauge" and substitute "22 gage"; sixth line, delete "while the inside reflecting surface of holders shall be of white enamel".

g. Sheet No. 16. - After "light proof continuous hinge" add "or concealed-type drop hinges".

h. Sheet No. 26. - Last line, insert "insulated" before "pull chain".

i. Sheet No. 43. - Delete sentences 3 to 7, inclusive, and 9 to 13, inclusive. Line 22, after "starters," insert "for preheat lamps". Add the following:

"Fixtures shall conform to Federal Specification W-L-331, type I or II, style B, class A. Reflectors shall be porcelain enameled steel. Reflectors having openings permitting an 8-15% upward component of light are acceptable. Sockets shall be of a type requiring an axial movement of the lamp for insertion and removal."

j. Sheet No. 44. - Delete sentences 3 to 6 inclusive, 8 to 11, inclusive. Line 20, after "starters," add the following:

"Fixtures shall conform to Federal Specification W-L-331, type I or II, style B, class A. Reflectors shall be porcelain enameled steel. Reflectors having openings permitting an 8-15% upward component of light are acceptable. Sockets shall be of a type requiring an axial movement of the lamp for insertion and removal."

k. Sheet No. 46. - Width of four light fixtures should be approximately 16 inches. Line 16, after "78%" insert "For two lamp fixtures and 75% for three and four lamp fixtures".

l. Sheet No. 47. - Line 12, delete "curved" and substitute "straight". Last line, add the following: "For two lamp fixtures and 75% for three and four lamp fixtures."

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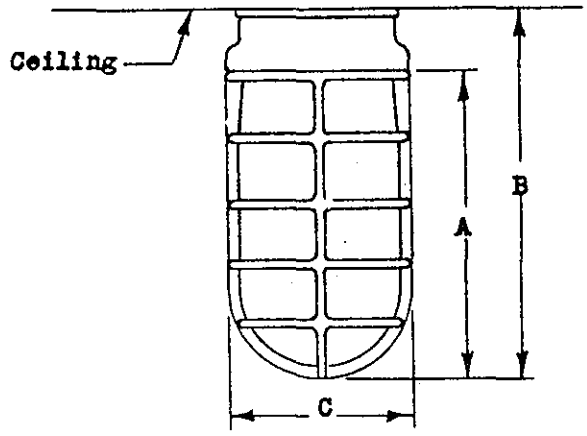
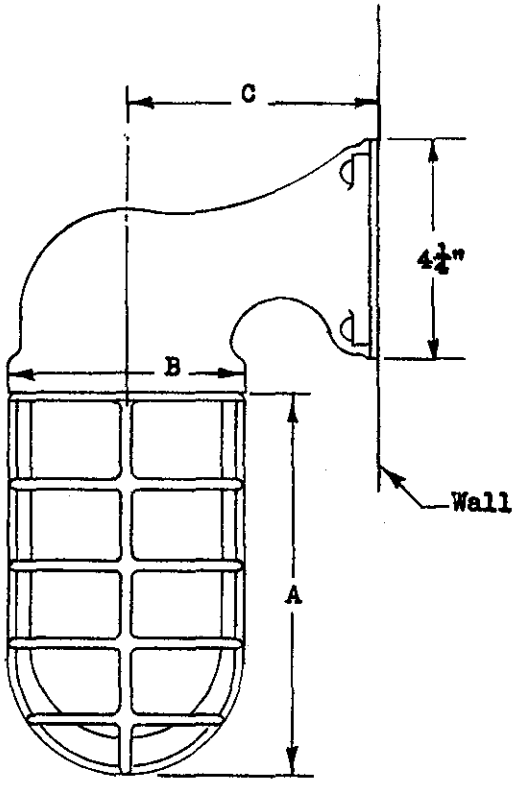


Type	Lamp Size	A	B	C
VG-1	100	6-7/8	8¼	4¼
VG-2	150-200	9-3/8	10¾	5¼

Ceiling type, heavy cast metal body with screw type cast metal guard and clear glass screw type globe. Provide screw terminal, heavy duty, porcelain lamp receptacle mounted in cast body with suitable impregnated asbestos gaskets. Cast body to mount directly on 4 inch round or cast outlet box with 4 non-ferrous screws. Provide suitable gasket for outlet. Ferrous metal parts shall have corrosion resistant finish.



Type	Lamp Size	A	B	C
VG-3	50-100	6-1/8	4-3/8	2-7/8
VG-4	150-200	8-5/8	5-3/8	2-7/8

Bracket, weatherproof, heavy cast metal angle body with screw type cast metal guard and clear glass screw type globe. Provide screw terminal, heavy duty, porcelain lamp receptacle mounted in body with suitable impregnated asbestos gaskets. Cast body to mount directly on 4 inch round or cast outlet box with 4 non-ferrous screws. Provide suitable gasket for outlet. Ferrous metal parts shall have a corrosion resistant finish.

SECTION 17

VENTILATING SYSTEM
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SECTION 17

VENTILATING SYSTEM

17-01. SCOPE. - This section covers ventilating systems, complete, for the Pumping Station. The systems consist of all ductwork (including engine radiator discharge ducts), louvers, gravity roof ventilators, dampers, and wall fan.

17-02. APPLICABLE PUBLICATIONS. - The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto.

a. Federal Specifications. -

QQ-A-359d.	Aluminum Alloy; Plate and Sheet 3003.
QQ-S-775a.	Steel, Sheets, Carbon, Zinc-coated.
TT-V-51c.	Varnish; Asphalt.

b. Air Moving and Conditioning Association, Inc., Bulletin. -

No. 110	Standards, Definitions, Terms, and Test Codes for Centrifugal, Axial and Propeller Fans.

17-03. GENERAL. - The contract drawings indicate the extent and general arrangement of the ventilating systems. The contractor shall be responsible for installing the systems as indicated and in accordance with these specification requirements.

a. Capacities. - Capacities of all equipment and materials shall be not less than those indicated.

b. Prevention of Rust. - Surfaces of ferrous sheet metal not otherwise specified shall be given a rust-inhibiting coating. Unless otherwise approved by the Contracting Officer, the rust-inhibiting coating shall consist of hot-dip galvanizing, an approved plastic coating, or bonderizing or phosphatizing followed by the application of a suitable rust-inhibiting primer and finish paint. Where rust inhibitor is specified hereinafter, any of the above methods will be acceptable

c. Standard Products. - The materials and equipment to be furnished under this section of the specifications shall be the essentially standard catalog products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate materials and equipment that have been in satisfactory use for at least 2 years. Where two or more units of the same type of equipment are required, these units shall be the products of a single manufacturer.

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17-04. MATERIALS. - Materials shall conform to the respective specifications and other requirements specified herein.

a. Aluminum Sheets. - Federal Specification QQ-A-359, temper H12 or H22, except aluminum for the gravity ventilators shall be of the hardest temper consistent with the forming operations involved in the work.

b. Asphalt Varnish. - Federal Specification TT-V-51.

17-05. MATERIALS LIST. - As soon as practicable, and before starting installation of any materials or equipment, the contractor shall submit to the Contracting Officer for approval a complete list in six copies, of materials and equipment to be incorporated in the work. This list shall include catalog numbers, cuts, and such other descriptive data as may be required. No consideration will be given to partial lists submitted from time to time. Approval of materials and equipment will be based on manufacturers' published data.

17-06. SHOP DRAWINGS. - Before installation of any items, the contractor shall submit complete shop drawings and such other descriptive data as the Contracting Officer may require to demonstrate compliance with the contract documents. Shop drawings for the following items shall be submitted: Fan, gravity roof ventilators, louvers, dampers, and duct work.

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If departures from the contract drawings are deemed necessary by the contractor, details of such departures including changes in related portions of the project and the reasons therefor shall be submitted with the shop drawings.

17-07. WORKMANSHIP. - Materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer to conform to the contract documents. The installation shall be accomplished by workmen skilled in this type of work.

17-08. FAN. - Fan shall be tested in accordance with the test procedures of the Air Moving and Conditioning Association, Inc., and shall conform to the AMCA standards where applicable standards exist. The AMCA certified-rating seal, where granted, will be evidence of conformance to this requirement. In the absence of the seal for fan covered by AMCA codes, the manufacturer's certificate of conformance to the above standards, including test procedures, shall be submitted. Unit not covered by present AMCA codes shall be tested in accordance with present AMCA test procedures, and the manufacturer's rating certificate to this effect shall be submitted. Fan and motor shall be provided with vibration-isolation supports or mountings. The fan shall be selected to produce the specified capacity at a noise level not in excess of that set forth by good engineering practice for the particular space and environment being ventilated. A fan that is deemed by the Contracting Officer to be objectionably noisy for the surrounding area, shall be replaced by a unit with an approved noise level, at no additional cost to the Government. Bearings shall be accessible for lubrication without dismantling fan or disconnecting ducts.

a. Centrifugal fan. - Impeller wheel shall be of the multiblade type, with forward or backward curved blades, shall be heavily and rigidly constructed, accurately balanced both statically and dynamically, and free from objectionable vibration and noise. Fan blades may be flat or airfoil design. Fan wheel may have one-extra-long bearing between the fan wheel and the drive. The bearings shall be self-aligning and self-oiling with adequate oil reservoirs, or may be the sealed ball-bearing type. The fan shaft shall be of steel, and shall be provided with key seat and key for the impeller hub or may have flattened shaft and setscrew. The fan outlet shall be of ample proportions. Motor enclosure shall be the totally enclosed type.

b. Wall Exhaust Fan. - Wall exhaust fan unit shall have a centrifugal fan directly connected to the motor. The fan motor shall be enclosed in an air-cooled motor compartment outside of the exhaust airstream. Fan-motor enclosure shall be the totally enclosed type. The unit shall meet all conditions specified in paragraph: Centrifugal fan hereinbefore, except as follows:

(1) Sealed, permanently lubricated sleeve or ball bearings with suitable provision for end-thrust, shall be provided.

(2) Weathertight housing shall be rigidly constructed of durable aluminum.

17-09. GRAVITY VENTILATORS. - a. Design. - The velocity through the neck of the ventilator shall be at least 35 percent of the velocity of wind over the head of the ventilator when the wind is directed horizontally, upward at angles of 30 degrees and 45 degrees, and downward 45 degrees and 30 degrees. The ventilators shall be designed to withstand stresses developed by winds up to and including 85 miles per hour, shall be waterproof and stormproof under all operating conditions, and shall be free from backdraft except in the event of interior negative pressure. The design shall be such that the ventilators will be capable of self-cleaning by the action of the elements, with provision for carrying water and wind-transported soil matter to the outside. Ventilators shall be similar and approved equal to Breidert air-x-hauster type 'F', size 30. Unless otherwise indicated, ventilators shall conform to the minimum requirements for performance regardless of wind direction and material weight without coating, set forth in the following table.

TABLE I. STATIONARY

Throat diameter (inches)	Material		Capacity [1] (cu. ft. per min.)			
	Base	Hood	Stack Height (feet)			
	Aluminum alloy (ga.)	Aluminum alloy (ga.)	20	30	40	50
30	16	18	1,310	1,420	1,510	1,600

[1] Capacity ratings included in this table are based on a wind velocity of 5 miles per hour and an exterior-interior temperature difference of 10 degrees F. for ventilators without screens. Capacity ratings for design conditions other than as stated shall be in accordance with the latest recommendations of the American Society of Heating and Air-Conditioning Engineers for the combined effects of wind and temperature.

b. Bases. - Bases shall be provided for all ventilators. The bases shall be factory-formed, shall be of square or round type as indicated, and shall be of the same material as the hoods. Duct shall be extended through the supporting roof construction a sufficient distance to permit installation of dampers as indicated on the drawings.

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c. Dampers. - Dampers shall be constructed of aluminum and shall be provided with chains or cables and required devices for holding damper in open, closed, or any intermediate position. Dampers shall have weather stripped edges designed for tight closure. Dampers shall be manually operated, as indicated, with necessary pulleys to hold chains or cable near ceiling and walls to prevent interference with operation of the traveling crane.

d. Construction. - Ventilators shall be adequately reinforced and well braced, with joints properly formed. Edges shall be wired or beaded, where necessary, to insure rigidity. Reinforcing members, braces, bolts, and rivets shall be of aluminum alloy of sufficient size to assure rigid and sturdy construction, shall be properly applied and installed in such manner as to avoid corrosion, and secured in an approved manner. Galvanic action between different metals in direct contact shall be prevented by nonconductive separators. All parts of aluminum ventilators, including fasteners, frames, and screens, shall be of the aluminum alloy specified. All soldering shall be even and smooth.

e. Screens. - Aluminum screens with aluminum frames shall be provided in the ventilators and shall be securely attached in such manner as to permit easy removal for cleaning on the roof. Screens shall be 1/2-inch mesh.

f. Finish. - Finish shall conform to paragraph 17-11f.

17-10. DUCTWORK. - a. General. - Ducts shall be constructed and erected in a workmanlike manner. The ductwork shall be constructed of aluminum sheets. Ducts, unless otherwise approved, shall conform to the dimensions indicated and shall be straight and smooth on the inside, with joints neatly finished. Ducts shall be anchored securely to the building in an approved manner and shall be so installed as to be completely free from vibration under all conditions of operation. Sheet-metal ducts shall be properly braced and reinforced with aluminum alloy angles or other approved structural members spaced not over 4 feet on centers. Joints shall be made substantially airtight, and no dust marks from air leaks shall show at connections. Laps shall be made in the direction of the airflow. All edges and slips shall be hammered down to leave a smooth interior duct finish. All buttons or bolt connections in standing seams shall be spaced not more than 4 inches on fixed centers, and shall be at the same centerline throughout the entire length of the duct. All ducts shall have cross break of sufficient center height to assure rigidity in the duct section. Unless otherwise indicated, the sheet-metal ducts and stiffeners shall conform to table II.

Table II. Sheet-metal thickness for rectangular duct construction.

Aluminum thickness (inch)	Maximum side (inches)	Type of transverse joint connections	Bracing
0.020	Up to 12	S, drive, pocket, or bar slips on 7-ft. 10-in. centers.	None
0.025	13 to 24	S, drive, pocket, or bar slips on 7-ft. 10-in. centers.	None

b. Engine Radiator Ducts. - Engine radiator ducts shall be sized to fit the louvered wall opening as shown on the drawings and diesel engine radiator flanged connection. The ducts shall be straight and smooth on the inside, with neatly finished joints. The ducts shall be properly supported from the floor in an approved manner so as to be completely free from vibration under engine operating conditions. The sheet metal used shall be 14 gage thick aluminum, reinforced with aluminum angles. A door shall be provided on the side of duct from each engine where indicated on the drawings. Door shall be mounted on inside of duct and arranged for opening inward to deflect air into the room. Operating rod and locking device shall be provided on each duct to hold door in any position. Duct connections to the radiators and to the wall louvers shall be made with flexible connections of 29 ounce neoprene-coated fiberglass suitably clamped to the ducts and radiator or louver.

17-11. LOUVERS. - a. General. - Fixed and manually operated extruded aluminum louvers shall provide where indicated. Manually operated louvers in full open position shall afford a minimum of 65% free ventilating area. The louvers shall be designed to resist a wind pressure of 30 pounds per square foot. Operators for louvers in ducts from engine radiators shall be arranged for operation of louver external to the ducts.

b. Louvers. - Louvers, blades, and frames shall be a minimum of 12 guage (081) 6063-T5 extruded aluminum alloy or approved equal alloy and temper. Entire unit members shall be rigidly assembled by welding.

c. Manually Operated Louver. - Manually operated louver shall consist of a set of uniformly constructed aluminum blades with interlocked felted edges. Blades shall be securely fastened to suitable pivot rods which shall be guided in non-ferrous oil-less type bushings of replaceable type or in ball bearing support devices with stainless steel balls and cadmium plated steel races. Blades shall be pivot-connected to a suitable operating bar which shall uniformly position the blades in open or closed position.

d. Fixed Louver. - Fixed Louver shall be weatherproof and leakproof type.

e. Bird Screen. - Bird screen shall be provided for all fixed louvers. Screen shall be mounted as extruded aluminum rewirable frame. Screen material shall consist of 1/2-inch aluminum.

f. Finish. - Aluminum louvers and screens shall be given a heavy anodizing treatment meeting the following requirements.

Anodizing Time	60 Minutes
Minimum Cooling thickness	.0008"
Minimum Coating at Per Sq. Inch	35 mg.

After anodizing, units shall be given two coats of clear lacquer.

17-12. ELECTRICAL WORK. - Electrical motor-driven equipment specified herein shall be provided complete with motor. Electrical equipment and wiring shall conform to SECTION 16, ELECTRICAL WORK. Electrical characteristics shall be as indicated. Motors shall be of sufficient capacity to drive the driven equipment at the specified capacity including an allowable service factor, without exceeding the nameplate rating on the motor. Manual or automatic control and protective or signal devices required for operation herein specified and any wiring required but not indicated on the electrical drawings shall be provided under this section of the specifications and shall conform to the applicable requirements of Section 16, ELECTRICAL WORK.

17-13. PAINTING AND FINISHING. - Hangers and other specified and unprotected ferrous metal shall be thoroughly cleaned and given one coat of asphalt varnish. The painting of ferrous metal work exposed within rooms, and fans, housings, and equipment external to operating room is specified in Section 27, PAINTING. Except where provided with a protected primer at the factory, ferrous metal specified to receive finish painting shall receive a prime coat as specified in SECTION 27, PAINTING.

17-14. TESTS. - Bearings shall be lubricated, and the speed and direction of rotation of fan shall be checked. The running current of motor shall be checked.

a. Report of Test Data. - Report of test data indicating the following in typed tabulated form shall be submitted to the Contracting Officer not less than 2 days before the final test of the system.

(1) Fan:

(a) Specified air quantity and static pressure.
(b) Installed motor horsepower.
(c) Measured air velocity.
(d) Computed air quantity.

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b. Final Tests. - Upon completion, and prior to acceptance of the installation, the contractor shall subject the fan to such operating tests as may be required by the Contracting Officer to demonstrate satisfactory functional and operating efficiency. Operating test shall cover a period of not less than 6 hours, and all tests shall be conducted at such times as the Contracting Officer may direct. If test does not demonstrate satisfactory operation, deficiencies shall be corrected to the satisfaction of the Contracting Officer. All instruments, facilities, and labor required to properly conduct the tests shall be provided by the contractor at no additional cost to the Government. The electricity required for testing will be furnished by the Government.

17-15. GUARANTY. - The following equipment to be furnished under this section of the specifications shall be guaranteed in accordance with the guarantee provisions set forth in the Special Conditions.

Gravity Ventilators
Wall Exhaust Fan
Louvers
Dampers

17-16. PAYMENT. - No separate payment will be made for the work covered under this section of the specifications, and all costs in connection therewith will be included in the lump-sum contract price for the Pumping Station.

SECTION 18

PUMP WITH ENGINES, VALVES, AND PIPING

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SECTION 18

PUMP WITH ENGINES, VALVES, AND PIPING

18-01. SCOPE. - This section covers the installation of two vertical axial flow pumping units with right angle gear units and diesel engines, piping and valves, and one electric motor driven sump pump, complete.

18-02. GENERAL. - The pumps, right angle gear units, and diesel engines shall be products of manufacturers regularly engaged in the production of this type of equipment, and shall be of the type, size, and capacity specified.

18-03. MATERIALS AND WORKMANSHIP. - a. General. - Materials used in the manufacture of the equipment shall be of the best quality used for the purpose in commercial practice. Workmanship shall be of the highest grade throughout and in accordance with the best standard practice for this type of equipment.

b. Material and Equipment Approval. - As soon as practicable and before starting installation of any materials or equipment, the contractor shall submit to the Contracting Officer for approval a complete list, in six copies, of material and equipment to be incorporated in the work. This list shall include shop drawings, catalog numbers, cuts, performance curves, and such other descriptive data required to assure compliance with the specifications. No consideration will be given to partial lists submitted from time to time. Approval of materials will be based on manufacturers' published data.

18-04. MAIN PUMP CHARACTERISTICS. - The pumps shall be of the vertical, single stage, axial flow type designed to handle storm water. All parts shall be of such design, strength, and proportions as to perform in a successful manner the work required. The pumps shall be guaranteed to deliver not less than 12,000 gallons per minute at a total head of 20.0 feet. Pump operating speed shall be not more than 920 revolutions per minute. The pumps shall operate smoothly and quietly without excessive vibration under any head condition indicated on the drawings. Each pump shall be connected through a right angle gear unit to a diesel engine. Each pump is to be mounted on a common base plate with the right angle drive. Each pump shall be fitted with a suction umbrella.

18-05. CONSTRUCTION OF PUMP. - a. Pump Bowls. - (1) The bowl of each pump shall be close grained cast iron. Each bowl shall be flanged both top and bottom and so arranged as to permit ready removal of the propeller from below. The walls of each bowl shall be of ample strength to safely withstand all stresses that will be imposed during erection and operation. Suitable eye bolts shall be provided to facilitate handling of the pump bowls.

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(2) Diffusion Vanes. - Diffusion vanes shall be cast integral with each pump bowl to guide the water into the discharge column. The hub of diffusion vanes shall form the support for the propeller guide bearings as well as the lower end of the shaft enclosure tube.

b. Propellers. - Each propeller shall be cast in one piece of either cast steel or manganese bronze. Each propeller shall be securely locked to the shaft in such a manner as to prevent damage in case the direction of rotation should become reversed for any reason. Each propeller shall be finished all over to a smooth surface and shall be dynamically balanced to avoid vibration.

c. Discharge Columns. - Each discharge column and elbow shall be not less than 20" diameter and shall be not less than 3/8 inch thick steel plate. Each discharge column shall be designed for suspension from the base plate and shall be so proportioned as to support safely the bowl and suction bell, and to withstand the hydraulic pressure thrust and any other load it may be subjected to during transportation, erection, or operation. Each discharge elbow shall be as indicated on the drawings and shall include an extension nozzle for connection to a flexible pipe coupling.

d. Shafting. - The pump and line shafts shall be constructed of corrosion-resisting metal conforming to requirements of Federal Specification QQ-S-763b. The shafts shall be of sufficient diameter to transmit the required maximum torque with a factor of safety of not less than eight (8) based on the ultimate strength of the material. The shafts shall be furnished in not more than two sections, and the sections shall be connected by means of an approved shaft coupling. Each shaft assembly shall include provisions for making any necessary vertical adjustments to the shaft after it has been assembled in the pump unit and without interferring with its alignment.

e. Bearings. - The bearings shall be of high-grade bronze, and of the removable sleeve type. The number and spacing of bearings shall be clearly indicated on the contractor's drawings. The weight of the impeller, the pump shaft, line shaft, couplings, and the thrust imposed by the pump, shall be carried independently by a roller or ball-thrust bearing incorporated in each right-angle gear unit. The guide bearings shall be of ample dimensions to withstand any load that will be imposed on them in the operation of the pumps, even though the rotation of the shaft should become reversed, and they shall be capable of operating continuously without objectionable rise in temperature under all variations of load. The bearings shall be inclosed in sectional sleeves, fully protected from coming into direct contact with the water.

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f. Lubrication. - (1) General. - Each pump shall be provided with a manually operated centralized pressure lubrication system, designed to deliver the proper predetermined or metered quantity of lubricant to each individual bearing. It shall positively indicate the proper or improper functioning of any individual metering device. Each pressure pump, individual metering devices and any other required auxiliary operating accessories shall be suitably mounted on the right angle gear unit base plate and the system shall be furnished complete and ready for operation including sufficient lubricant to fill the pressure pump lubricant reservoir. The lubricant furnished shall be that recommended by the pump manufacturer and approved by the Contracting Officer.

(2) Pumping Units. - Each manually operated central pumping unit shall be a complete assembly, consisting of a positive displacement type pump, a lubricant reservoir, a manually operated flow directing valve, a suitable pressure gage to indicate the pump discharge pressure and such auxiliary accessories as required to give a complete and workable unit. The lubricant reservoir shall be of suitable metallic construction, shall have a capacity of not less than 4 lbs. of lubricant, shall be provided with suitable means that will insure positive priming of the pump at all times, an indicator to show the quantity of lubricant in the reservoir, and a screened fill connection to permit filling the reservoir by a transfer pump without exposing the lubricant to the atmosphere.

(3) Metering Valves. - A metering or measuring valve shall be provided for each bearing and it shall operate independently. It shall be fully hydraulic in its operation requiring no internal springs or check valves. The valve for any given lubricated device shall have sufficient capacity to deliver a maximum quantity of lubricant equal to approximately 1/3 of the clearance volume of the bearing served, each time the measuring valve is discharged.

(4) Piping. - Piping of each system shall be copper or brass tubing flared or compression type connectors. Piping located below operating room floor shall be adequately protected and rigidly supported. Each individual lubricant line shall be provided with a "Tee" fitting, located immediately below the respective metering valve and accessible from the operating room, which shall be provided with a standard 1/4 inch lubricant fitting so that each individual line may be fully charged without using the pump of the lubricating system. Size and strength of pipe and type and strength of fittings shall be as recommended and guaranteed by the lubrication system manufacturer, but in no case shall the bursting pressure of the pipe or tubing used be less than three time the maximum pressure. A check valve shall be provided in the lubricating lines to all bearings exposed to water pressure to prevent the entrance of water into the respective measuring valves. A hand type lubricant gun for use in charging lubrication lines and for emergency lubrication shall be provided. One portable hand transfer pump for transferring lubricant to the reservoirs of the lubrication system shall be provided.

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(5) Tests. - Each complete lubricating system shall be tested as deemed necessary by the Contracting Officer to determine that the system meets the operational requirements specified. At least one valve of each size furnished shall be tested with the lubrication line removed from its bearing and fitted with a pressure relief valve and pressure gauge. The pressure relief valve shall be adjusted at system design pressure and the system operated through one or more cycles as required to obtain an accurate measurement of the quantity of lubricant determined, which shall be within plus or minus 20 percent of the theoretical delivery of the respective valve. Any component parts which are damaged as a result of these tests or which fail to meet the requirements of the specification shall be replaced, reinstalled and retested at the contractor's expense.

g. Bases. - The base plates shall be steel plate of adequate thickness to support the weight of the pump and gear unit plus the maximum hydraulic thrust of the pump. Plates shall fit the seat angles indicated on the drawing and not less than eight anchor bolts shall be provided and installed on each plate. Plates shall be accurately finished to receive the suspension column of the pump housing and the right angle gear unit so that when fully assembled, the right angle gear unit, pump, and intermediate shafts will be concentric, the rotating parts running freely without binding. At point where the intermediate shaft or pipe sleeve extends above the bottom of the base plate, provision shall be made for packing the drive shaft so that floor drainage or dirt will be excluded from the interior of the sleeve and intermediate bearings. Eye bolts shall be tapped into the base plate to facilitate lifting and removal.

h. Shaft Enclosure Tube. - Each shaft enclosure tube shall be constructed of steel. Each tube shall be watertight and shall enclose the line shaft from the top of the pump bowl to the base plate. Each tube shall be adequate to rigidly support the intermediate shaft bearings. Each shaft tube shall have tapped connections for grease lubrication connections to bearings.

i. Suction Bells. - Each pump shall be equipped with an umbrella type suction bell. Each suction umbrella shall be constructed of steel plate not less than 3/8 inch thick or close grained cast iron not less than 5/8 inch thick. Each bell shall be flanged at the top and bolted to the pump bowl flange and shall be properly designed to prevent vortex and to reduce entrance losses to a minimum. Each bell shall be provided with lifting eyes to permit easy removal.

j. Discharge Piping. - The discharge piping from the flexible coupling to the flap valve shall be same size as pump discharge and shall be, Class A, American Water Works Standard, cast iron, flanged at flap valve end. Each flange shall be faced and drilled to the 125 - Pound American Standard. Each pipe shall have an intermediate flange located in the center of the wall cast on the pipe. Each intermediate flange shall be of the same diameter and thickness as the standard pipe flange.

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k. Flap Valves. - The flap valves shall be flanged frame "Chapman" table No. 25 or approved equal with bronze rings in both frame and flap and bronze hinge pins. The body and flap shall be suitable for not less than 43 pounds per square inch working pressure. Flanges shall be faced and drilled in accordance with the 125-Pound American Standard. The flanged connections between the flap valves and the discharge pipes shall be bolted together with steel bolts having hexagonal head and nuts.

l. Flexible Pipe Couplings. - Each pump discharge elbow shall be connected to the wall piece discharge pipe by means of a flexible coupling similar and equal to Style 62, designed for connecting steel pipe to cast iron pipe, as manufactured by Dresser Manufacturing Division, Dresser Industries, Bradford, Pa.

m. Gear Unit Support. - Each right angle gear unit shall be supported on a fabricated steel base of sufficient height to suit the gear unit furnished. Each base shall have adequate openings for easy access to the pump shaft coupling and stuffing box.

18-06. RIGHT ANGLE GEAR UNITS. - a. General. - Each gear unit shall be the self-contained type designed for transmitting power from the horizontal engine shaft through spiral bevel gears to the vertical pump shaft. The horsepower rating shall be in accordance with the recommended practice of the American Gear Manufacturers' Association. The gear units shall have a service factor of not less than 1.25. Each gear unit shall be essentially a standard unit that is regularly manufactured for service similar to that required by these specifications.

b. Housings. - Each gear unit housing shall be of rigid, compact design made of close-grained cast or iron steel plate. The design of the housing shall be such that all bearings are supported in the base section, and the cover may be removed without disturbing the bearings, gears, or oil piping. All joints shall be machine-finished, oil-tight, and dust-proof. Suitable cover-plates shall be provided that will permit easy access to the interior for examination and adjustment of the parts. Eye bolts shall be provided for lifting the unit.

c. Gears. - The spiral bevel gears shall be of the precision generated, curved-tooth type, made of alloy steel and heat-treated and lapped. The gears shall be designed to give the proper ratio and transmit the power without undue strain. Gears and pinions shall be adequately supported between bearings, and so mounted that they will be in precise alignment at all times.

d. Shafts. - The shafts shall be made of forged, heat-treated steel and shall be of ample size to provide against deflection. The shafts shall be supported in anti-friction bearings of the radial thrust type, widely spaced. A thrust bearing of the ball or roller bearing type shall be incorporated and shall be of sufficient capacity to take the

thrust of the pump in addition to the weight of the rotating parts. The bearings shall be of ample size and rating for the duty required. Provision shall be made to provide vertical adjustment for each pump shaft. Each vertical shaft shall be of hollow shaft design connected at the top through a clamp coupling to the vertical pump shaft. Each coupling shall be provided with suitable shear pins designed to allow engine and gears to run free in case the pump should clog. Two spare sets of shear pins shall be furnished with each gear unit.

e. Lubrication. - A lubricating system shall be furnished for each unit. Each lubrication system shall be capable of supplying sufficient lubricant to all parts when the unit is running at a speed corresponding to approximately one-half of the rated speed. Each system including all piping shall be self-contained within the gear unit, with adequate oil supply carried in the base of the gear housing. Suitable piping shall be provided to drain the oil from the housing. Each circulating oil pump shall be self-priming, of the positive flow type. An oil lever indicator, oil strainer, oil flow indicator, and an oil pressure gage of approved design shall be provided on each unit. Piping shall be of brass or copper with sufficient unions inserted in the lines so that the piping can be readily dismantled. Each unit shall be self-cooling without the use of cooling water and when operating continuously under rated load the temperature of the lubricating oil shall not exceed 160 degrees F. at an ambient air temperature of 90 degrees F. Oil seals shall be provided at the shaft outlets but no stuffing box or glands shall be used.

18-07. DIESEL ENGINES. - a. General. - The engines shall be naturally aspirated full diesel type having not less than four cylinders in line. The engines shall be of a late design and a current model, standard with the manufacturer, and shall be the product of a reliable manufacturer who can show at least 5 years of experience in the manufacture of engines of the type specified and for similar duty. Each engine shall be mounted on a structural steel base and adequate anchor bolts shall be provided and installed in the concrete base shown on the drawings.

b. Rating. - The engines shall be operated at not more than 2,000 rpm. The published continuous duty rating of each engine at the speed required to meet specified pump capacity, after deducting power required for all engine driven auxiliaries, shall be not less than that necessary to operate the gear unit and pump at any total head condition between 0 and 22 feet. The continuous duty rating shall not exceed 75 percent of the maximum published rating of the engine operating on No. 2 diesel fuel oil.

c. Flexible Couplings. - Each flexible coupling shall be of an approved metallic type, complete with a suitable guard. Each coupling shall be rated at not less than 200 percent of the maximum horsepower required by the pump. Each coupling shall be easily disengaged to permit operation of the engine without operating the gear unit and shall be similar and approved equal to the Waldron Cutout Type Coupling as manufactured by the John Waldron Corporation, New Brunswick, New Jersey.

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d. Fuel Injection Systems. - Each fuel injection station shall be mechanical type with individual pump and injection nozzle for each cylinder or single pump with individual injection nozzles for each cylinder. A built-in engine-driven fuel pump shall be provided to pump the fuel from fuel storage tank to each engine. A full flow strainer shall be provided and mounted on each engine unit. All fuel oil piping for each engine shall be installed complete including connections to the fuel oil storage tank. Engine fuel pumps shall be capable of lifting fuel from the storage tank as shown on the drawings.

e. Lubricating Oil Systems. - Each lubricating oil system shall be of the pump pressure type with the pressure being supplied by a built-in engine-driven pump with necessary relief valves and pressure regulators. A full flow strainer, and a full flow type lubricating oil filter shall be provided on each engine. Each engine shall be of the wet sump type with all oil stored in the engine crankcase sump without the necessity of an auxiliary tank. All lubricating oil piping shall be completely installed on the unit.

f. Cooling Systems. - The cooling system for each engine shall consist of a radiator, engine-driven fan together with centrifugal jacket water pump. Each radiator shall be mounted on the engine structural base directly in front of the engine. Each radiator fan shall be driven by V-belt and shall draw the air across the engine and discharge forward through the radiator. Protection for the operators and the cooling cores shall be provided by metal fan guards. Each engine shall be equipped with an automatic temperature regulator for the control of the jacket water and, if necessary, lubricating oil temperatures. The temperature regulators shall be of the type which will maintain full water flow through each engine. Each radiator and fan shall be of proper capacity to adequately cool the engine with an entering air temperature of 100° F. and against static pressure imposed by ductwork and louvers. Each engine cooling system shall be filled with an aqueous solution of ethylene glycol which shall protect the engine and radiator system against freezing at a temperature of minus 20° F. All water and lubricating oil piping shall be furnished and installed complete.

g. Governors. - Each engine shall be equipped with a governor which will maintain the engine speed within 5 percent of the predetermined setting under any load between no load and full load. Each governor shall be provided with an adjustment knob which will permit manual setting at any speed between 60 and 100 percent of the speed required to meet specified pump capacity.

h. Overspeed Stop and Tachometer. - Each engine shall be equipped with an overspeed stop and an indicating tachometer. Each overspeed switch shall be adjustable and shall automatically shut off the fuel supply to the engine when the engine speed exceeds the predetermined setting. The overspeed stop devices shall be separate and independent from the engine governors.

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i. Exhaust Piping. - (1) General. - The exhaust piping shall be provided and installed as indicated on the drawings. The flexible exhaust connections shall be seamless, corrosion resisting, metal conforming to the requirements of Federal Specification QQ-S-766b, and shall be similar and equal to that manufactured by Atlantic Metal Hose Co., Inc., New York. The piping shall be standard weight genuine black wrought iron pipe with flanged cast iron fittings.

(2) Silencers. - The exhaust silencers shall be of the proper size for the engine and shall be type designed for industrial level silencing. Each silencer shall be equipped with removable bronze drain plugs.

(3) Insulation. - The silencers, flexible connections, and all pipe and fittings within the building shall be insulated with two one-inch thicknesses of insulation conforming to Federal Specification HH-I-523a. The insulation shall be installed with staggered joints and shall be covered with 8-ounce canvas jacket.

j. Starting Systems. - (1) Starters. - A heavy-duty electric cranking motor rated at not less than 12 volts shall be provided for starting each engine. Each cranking motor shall be capable of cranking the engine at sufficient speed to insure starting and shall be controlled by a push button mounted on the engine.

(2) Batteries. - A storage battery shall be provided for each engine. Each battery shall have sufficient capacity to provide a 3-minute continuous cranking of the complete unit under operating conditions. Each battery shall be of the voltage required by the starting system and shall be of heavy duty design. Minimum rating shall be 200 ampere hours. Each battery shall conform to the specifications for United States Government award by the Treasury Department, Procurement Division, Branch of Supply for lead-acid storage batteries, Item 17, B8630a-2. A suitable shelf or platform with an acid-proof rubber or lead tray shall be provided on or located adjacent to each engine base for mounting each battery. A hydrometer syringe shall be included.

(3) Battery Charger. - The battery charger is specified and will be provided under Section "ELECTRICAL WORK".

k. Engine Control Panel. - A metal engine control panel shall be provided and installed on the side of each engine. The following instruments and equipment shall be mounted on each panel.

Tachometer

Lubricating-oil pressure gage

Engine water temperature gage

Manual throttle and stop control

Starter button

18-08. FUEL OIL STORAGE TANK AND PIPING. - a. General. - The storage tank shall be of capacity as shown on the drawings, horizontal, welded steel, non-pressure-type. The storage tank shall be constructed in accordance with the standards of the National Board of Fire Underwriters', and shall be of the size and shape shown on the drawings. The tank shall be tested and proved tight against leakage under a test pressure of not less than 5 pounds per square inch.

b. Tank Gauge. - An oil-level indicating device of the hydraulically operated type shall be installed in conjunction with the tank. Gauge element shall be run in electrical conduit as shown on the drawings. Mount gauge on wall in pump room as indicated on drawings.

c. Cleaning and Painting of Underground Tank. - Underground storage tank, before being placed in the ground, shall be cleaned and painted as follows: The tank shall be cleaned thoroughly of all loose rust, blisters, loose scale, oil paint of a type different from the field primer, and other substances that would interfere with proper adhesion of the protective coating. Mill scale that cannot be removed by hand wire-brushing need not be removed. Oil and grease shall be removed with mineral spirits or other acceptable solvent having a flash point higher than 800° F. After cleaning, a primer coat shall be applied to the outside of the tank only. Materials shall consist of processed coal-tar pitch and refined coal-tar oils conforming to Military Specification MIL-P-15147C suitably blended to permit application by brush or spray. The primer shall contain no highly volatile solvents or added pigments and shall dry hard within 6 hours. The primer shall not be heated, but the temperature of the metal and the primer temperature at time of application shall be 60° to 80° F. After the prime coat has become hard to the touch, an enamel coat composed of a specially processed coal-tar pitch combined with an inert mineral filler shall be applied hot, in a layer not less than 1/16 inch thick and in accordance with the manufacturer's recommendations. The enamel shall be free of all asphalt. The use of fluxing oils or thinners to reduce cracking susceptibility in cold weather will not be permitted. Primers and enamels herein mentioned shall not sag or flow from a vertical surface when exposed to an atmospheric test temperature of 160° F., and shall not become brittle, crack, check, or peel when exposed to an atmospheric temperature of minus 20° F. After the enamel is completely applied and cold, all coated surfaces shall be tested with an electric wire-brush holiday detector. The wire brush shall be placed flat in contact with the enamel surfaces and passed over the surface once only at the rate of approximately 35 to 50 feet per minute. Any evidence of missed places will be indicated by an electric spark between the brush and the metal surface. All missed places so indicated shall be marked by chalk or crayon and promptly repaired by a single application of hot enamel. No recheck of repaired areas will be required.

d. Tank Equipment. - (1) Atmospheric Vent. - The storage tank shall be provided with a separate 1-1/4-inch atmospheric vent equipped with a screened vent cap which shall terminate as shown on the drawings. Vent shall be combined with whistle device located in the tank vent tapping.

(2) Fill Connections. - The combination fill lines and stick well on the storage tank shall be 2 inches in size and shall enter the top of the tank. A 1-1/2-inch branch fill line with screwed cap shall be extended to the side of the building and shall terminate 3 feet above grade.

(3) Suction Connections. - The suction lines shall extend from the top of the tank and shall be carried underground, through the sump chamber to the suction of the engine fuel oil pumps and hand pump as indicated on the drawings. The final connection between the suction pipe and pumps shall be by means of a union at the hand pump, and flexible hose connections at the engine pumps. Suction lines in the tank shall terminate 3 inches from bottom of the tank.

(4) Return Connection. - The return line shall extend from the top of the tank and shall be carried underground, through the sump chamber to the engine fuel oil pumps. The final connections between the return pipe and pumps shall be by flexible hose connections.

e. Fuel Oil Piping System. - Fuel oil supply and return piping shall be Type "K" copper tubing with flare pattern fittings. Valves for this system shall be bronze body 150-pound class. Fill, vent, and overflow piping shall be steel pipe with malleable iron fittings.

f. Hand-Operated Fuel Pump. - Provide and install a hand-operated fuel pump of the internal gear type. Pump shall be suitable for taking suction from the fuel oil storage tank and shall be self-priming and free from air binding when handling No. 2 Diesel fuel oil. Pump shall be bracketed to wall in a position of easy access and to permit uninterrupted and unobstructed operation.

18-09. SUMP PUMP AND ACCESSORIES. - a. General. - The contractor shall furnish and install one vertical electric motor driven centrifugal sump pump complete with discharge piping, check valve, and gate valve as indicated on the drawings.

b. Description. - (1) Pump. - The pump shall have capacity indicated on the drawings.

(a) Casing. - The casing shall be cast iron accurately machined to provide uniform clearance for impeller and rigid connection to the motor plate through a wrought iron pipe to insure positive alignment. A strainer of corrosion resistant material shall be securely attached to the suction side of the casing.

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(b) Impeller. - The impeller shall be cast bronze of either the open or semi-inclosed non-clogging type, accurately machined and finished to produce high efficiency. It shall be securely attached to the drive shaft by a key and lock nut with provision for easy removal and replacement.

(c) Shaft. - The shaft shall be of forged steel turned and ground and of sufficient diameter to transmit the power of the motor and operate at maximum speed without vibration.

(d) Bearings. - The upper bearing shall be a combined radial and thrust type antifriction bearing, grease lubricated. The lower bearing shall be made up of a non-seizing, non-scoring high-lead-bronze bearing bushing with a grease reservoir. The reservoir shall be connected through copper tubing to an Alemite or Zerk Fitting above the pit cover.

(e) Coupling. - The pump shall be directly connected to the electric motor through a flexible coupling of sufficient size to transmit the maximum power of the electric motor.

(f) Motor. - The pump shall be driven by vertical, drip-proof motor. The motor shall have a rating of not less than 3/4 horsepower with a limiting temperature rise of 40 degrees centigrade, and shall have class "A" insulation with moisture and oil proof treatment. The motor shall be equipped with antifriction bearings, sealed against dirt and having provision for lubrication. The motor shall be mounted securely and in perfect alignment to the pump, through a motor extension base and floor plate.

(g) Floor Plate. - The floor plate shall be of size indicated on drawing and of steel plate of ample thickness to withstand the total load of the pumping unit complete and to resist vibration when the pump is in operation. The floor plate shall be bolted securely to concrete floor with anchor bolts.

(h) Switch. - The motor shall be actuated by an "on-off" switch and a combination magnetic starter mounted on the wall. The starter shall be equipped with three overload devices and shall be installed in a cast iron NEMA type 4 inclosure.

(i) Pipe, Valves and Fittings. - Pipe shall be galvanized wrought iron conforming to Federal Specification WW-P-441, Standard Weight. Gate valves shall conform to Federal Specification WW-V-54, Type 1, Class A, except it shall be equipped with extension stem, floor box and Tee handle wrench for operation from the operating room floor. Check valves shall be screwed bronze swing check type conforming to Federal Specification WW-V-0051.

18-10. COLD WATER PIPING. - The cold water service piping from approximately 6 inches within the building wall to a point not less than 5 feet from the building shall be copper tubing type "K", annealed. Cold water piping within the building shall be type "L", hard-drawn. Fittings shall be cast-brass or wrought-copper suitable for sweat or brazed connections for use with hard-drawn tubing, and flared-pattern for annealed tubing. Tubing shall conform to Federal Specification WW-T-799. A gate valve and drain shall be installed inside the building. The gate valve shall conform to Federal Specification WW-V-54 modified for use with copper tubing. Hose faucet shall be brass with metal handle and spout with 1" hose thread.

18-11. INSTALLATION. - The contractor shall install, erect, attach, or build into the structure all machinery, piping, and other metal work in a workmanlike manner as shown on the drawings or directed by the Contracting Officer. Wherever possible all parts shall be made accurately to standard gauge to facilitate replacement and repair. All work of the installation of the equipment shall follow the best modern practice in the installation of machinery of this type, notwithstanding any omission from these specifications. All work of installation shall be done by mechanics skilled in their various trades. The equipment shall be anchored to concrete foundations by means of steel anchor bolts. The anchor bolts shall be set at the time of placing the concrete by means of templates furnished by the equipment manufacturer. The concrete foundations for the diesel engines shall be constructed to the dimensions as recommended by the equipment manufacturer and shall be securely attached to the structural concrete floor by means of steel dowels. The complete pumping units shall be set accurately plumb. The equipment shall be given a touch-up coat of paint as required before finish painting is done (See Section 27).

18-12. TESTS. - a. Shop. - (1) Pumps. - Capacity and efficiency tests shall be made on one pump at the manufacturer's plant if feasible, and if not, a model test shall be made to insure compliance with these specifications. In the tests the relationship of the propeller inlet, bottom of the sump, the pumping range, and the 3'-6" distance of centerline of the pump to two adjacent sides, as shown on the drawings, shall be maintained. Readings shall be taken at not less than 5 points at uniform intervals to obtain curves of capacity, efficiency, and horsepower over the complete range of total head from 4 to 22 feet. If a model is used for the tests it shall be tested in strict accordance with the Tenth Edition of the "Standards of the Hydraulic Institute", 1955, as revised 1958, and hereinafter referred to as the "Institute Standard". The model test shall consist of a propeller in no case less than 10 inches in diameter, and exactly homologous to the proposed pump and water passages. The model test heads shall be the prototype head and shall include the water passages from the sump chamber through the pump, discharge column, and discharge piping. For the purpose of this contract, the efficiency of the model shall be considered the efficiency of the prototype pump only to the extent that values

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of efficiency, as determined by model test, will not be increased or adjusted by computation in order to estimate the efficiency of the prototype pump. Tests shall be witnessed by a representative of the Contracting Officer. Upon completion of all tests, the contractor will furnish the Contracting Officer five (5) copies of the final test report showing a narrative description of the test; all pertinent data used in the test; all curves used in or determined by the test; methods of interpolation; photographs; outline drawing of the set up; and other data pertinent to the test or as may be required by the Contracting Officer.

(2) Diesel Engines. - Each engine will be inspected and tested in the shop by an authorized representative of the Contracting Officer. A typewritten record of the tests, including observations, calculations, results and graphs, shall be submitted to the Contracting Officer by the manufacturer, together with a sworn statement from the person supervising the tests. The engine shall be tested for satisfactory operation under the following conditions.

(a) The engine shall be run continuously for twenty-four (24) hours at full-load, which shall be equal to the continuous horsepower rating required by paragraph 18-07b, followed by a one-hour run at maximum horsepower output of the engine.

(b) The governor shall be checked by means of a tachograph with the engine operating under various loading conditions ranging from no load to maximum load of the pump.

(c) Immediately after running tests for the engine the Contracting Officer or his representative may require that the engine be opened for inspection.

b. Field Tests. - After installation, each complete unit (diesel engine, right angle gear unit, and pump) shall be operated and tested for a period of eight (8) hours at the heads available at the time of test, to demonstrate that it is in satisfactory operating condition and free of damaging vibration. Any alterations necessary to bring the units up to the requirements of the specifications shall be made by and at the expense of the contractor.

c. Cost of Testing. - The cost of all testing shall be borne by the contractor, except for the Government's representatives, and shall be included in the contractor's bid price.

18-13. PAINTING. - Shop and field painting of materials and equipment shall be in accordance with the provision of Section 27. Such retouching as may appear necessary in the opinion of the Contracting Officer shall be done with the same shade of paint as the shop coat. All finished surfaces to be exposed to the atmosphere during shipment shall be coated with a heavy rust preventative compound.

18-14. GUARANTEE. - All items of equipment furnished under this section shall be guaranteed in accordance with the guarantee provisions of the SPECIAL CONDITIONS.

18-15. PAYMENT. - No separate payment will be made for all work specified in this section and all costs in connection therewith shall be included in the lump sum contract price for Item "Mechanical Work - Pumping Station".

SECTION 19

SLUICE GATES
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SECTION 19

SLUICE GATES

19-01. SCOPE - This section covers the installation and setting of the sluice gates, complete, for the Pumping Station. The sluice gate for the intake structure is specified and included under Section 24.

19-02. APPLICABLE SPECIFICATIONS - The following American Water Works Association Specification forms a part of this specification.

C501-41T Sluice Gates

19-03. GENERAL - The sluice gates shall be a product of a reliable manufacturer who can show at least 5 years of successful experience in the manufacture of similar gates. The gates shall be made of the materials and types as specified herein. If any departures from the drawings or specifications are deemed necessary by the contractor, details of such departures and the reasons therefor shall be submitted as soon as practicable to the Contracting Officer for approval. No departures shall be made without the prior written approval of the Contracting Officer.

19-04. SHOP DRAWINGS - Complete show drawings of the sluice gates shall be submitted to the Contracting Officer for approval in accordance with the requirements of Part II, Special Conditions, prior to the initiation of any work. The drawings shall show the details of construction and the methods of operation and installation and shall be fully dimensioned.

19-05. DESCRIPTION - a. General - The gates shall be of the materials hereinafter specified and shall be designed for the maximum static head above the top of the gate as hereinafter specified. The dimensions of the gate openings shall be 4 foot wide by 4 foot high in the clear. Each gate shall be operated by means of a rising stem hoist actuated by an electric motor. When seated the gates shall be practically water-tight.

(1) Station Inlet Gate. The station inlet gate shall be of the flat frame, unseating pressure type with bottom and side wedges and with "F" sections 15 inches long embedded in the wall and shall be designed structurally for a mixmum unseating head of 16 feet above the top of the gate and for a maximum operating head of 4 feet above the top of the gate.

(2) Discharge Conduit Gate. The discharge conduit gate shall be of the flat frame, seating pressure type, with "F" section 15 inches long embedded in the wall and shall be designed structurally for a maximum seating head of 16 feet above the top of the gate and for a maximum operating head of 6 feet above the top of the gate.

19-06. GATES - a. General - The gates shall conform to all the requirements of paragraph 19-05, and AWWA Specifications C501-41T for Sluice Gates and as supplemented or amended hereinafter.

b. Gate Frame - Gate frame shall be made of corrosion resisting alloy iron casting conforming to Military Specification MIL-G-858A, Class 1, and shall be of the flat framed type with rear face machined and drilled for bolting directly to wall thimble. The gate guides shall have machined grooves their entire length to match the machined tongues of the gate leaf. The sliding clearance between the gate leaf tongue and the guide shall be at least 1/16" on each side of the gate leaf. The bolts and nuts for attaching the gate guides shall be monel.

c. Gate Leaf. - Gate leaf shall be made of corrosion resisting alloy iron casting conforming to Military Specification MIL-G-858A, Class 1, with both horizontal and vertical ribs of sufficient size to withstand the full hydrostatic pressure without deflection of the leaf. A pocket for the gate stem nut shall be cast integrally with the gate leaf.

d. Seal Strips. - The gate frame and the gate leaf shall have machine finished groove into which the monel seal strips shall be pressed and/or otherwise securely anchored in place. The monel seal strips shall be machined to a true surface after the installation on both the gate frame and the gate leaf.

e. Gate Stems. - The gates shall have rising stems of sufficient size to withstand safely, without buckling, the maximum thrust of the hoist. The gate stems shall be cold rolled steel. The sections of each stem shall be joined together by solid manganese-bronze couplings threaded and keyed to the stems. Each stem shall be furnished with stem guides so located where shown on the drawings. All stem guides shall be bronze bushed and adjustable.

19-07. FLOORSTANDS. - a. Each gate shall be operated by means of an electric motor driven floorstand constructed of high grade cast iron or steel with provisions made for attaching removable stem covers to the top cover plate. Each floorstand shall be complete with electric motor, controls, and position indicator, and shall be of sufficient capacity to raise and lower the gates against the maximum operating head at a speed of one foot per minute. Floorstand shall also be provided with a hand wheel for hand operation. The hand wheel shall be disengaged automatically or so that the hand wheel will not revolve during motor operation.

b. The pedestals and gear cases shall be made waterproof. A suitable torque plate shall be provided at the base of each pedestal. Electrical contactor cases and push button cases shall be cast as integral parts of each pedestal and shall have cast iron covers with machined and gasketed water-tight and dust-tight joints.

c. All gears shall be of steel except worm gears which shall be nickle bronze, all properly designed for the service intended. The gear shafts shall have anti-friction bearings and suitable provisions shall be made for lubricating the bearings and gears. Gearing shall be enclosed in water and dust tight casings.

d. Suitable Visual Indicators shall be provided so that the exact position of the gates can be determined at all times. The indicator shall consist of a vertical monel plate attached to the stem cover and extending over the full range of gate travel from open to close position. The indicator shall be graduated in feet and tenths of feet, with numerals every foot and half foot intervals. The monel fingers shall have an adjustable pointer extending to the graduated plate. Each gate position indicator shall be clearly visible from the floorstand push button station. The slot in the stem cover for the floorstand in the discharge conduit shall be weatherstripped with rubber or other suitable flexible material to make the slot weathertight and yet not interfer with the movement of the finger.

e. The electrical motors and starters shall conform to requirements of Section 16. The motor shall be rated at the horsepower required to give a gate hoisting speed of one foot perminute and rated 208 volts, 3 phase, 60 cycles, A. C. The motor shall be the single-spread, high torque, low-starting current type, and shall be designed for 30 minute operation at rated load and voltage without exceeding a temperature rise of 55 degrees C. above an ambient temperature of 40 degrees C. Equipment shall be provided with watertight enclosures.

f. The Motor Control. - The motor control shall consist of a magnetic, reversing type starter and push button station. The starter shall be controlled by means of a three button station for raising, lowering, and stopping the gate with "open", "close" and "stop" buttons plainly indicated. Two indicating lamps, a green lamp for "open" and a red lamp for "close" shall be furnished for each control station. Quick break limit switches shall be provided that will cut out the motor at any predetermined position on both the opening and closing movements of the gate. An electrical torque switch shall be provided in the closing side of the gate movement control and shall be arranged to open the motor circuit when the gate is seated or strikes an obstruction. The switches shall be housed in oil tight cases and shall be equipped with quick break contacts with micrometer adjustment. In addition to the local control station, the floorstand for the gate in the discharge conduit shall also be supplied with a remote control station for mounting in the pump house. The remote control station shall be complete with pushbuttons and indicating lamps.

g. All equipment wiring installed by the manufacturer as part of the equipment shall be placed in suitable ducts cast in the stand or accessories, or shall be run in rigid steel conduit. Insulated wire

shall be 600 v, oil base rubber and shall conform to the requirements for Insulated Wire and Cable as specified in Section 16. The wiring shall terminate at a suitably enclosed terminal block.

h. Housing. - The contractor shall design, furnish and install a removable sheet metal housing for the discharge conduit floorstand. The housing which shall enclose the hoist shall be designed to slide down over the hoist and shall be fastened in the floor by swing bolts which are accessible from the inside only. The doors of the housing shall be tamper proof and shall be provided with a padlock and chain. The doors shall be arranged to provide access to the motor control and hand wheel. The housing shall be steel not less than 12 gauge. Painting of the housing shall conform to requirements of Section 27.

19-08. WALL THIMBLE. - The wall thimble shall be corrosion resisting alloy iron casting conforming to Military Specification MIL-G-858A, Class 1, Type "f", twelve inches depth, with machine finished face for contact with the gate frame. The thimble shall be equipped with monel studs and monel nuts for the gate.

19-09. PAINTING. - Before exposure to the weather and after thorough cleaning to remove all rust, dust, grease, and other foreign matter, floorstands, cranks, and similar parts customarily finished at the shop, shall be shop primed with treatment customary with the manufacturer, except as otherwise stated in Section 27. Sluice gate, frame and thimble, specified to receive special paint treatment shall be given a temporary shop coat and this shop coat shall be removed during surface preparation prior to required painting. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resisting coating. Painting shall conform to the requirements of Section 27.

19-10. INSTALLATION. - a. Gates. - The gates shall be completely assembled with disks wedged lightly but firmly in their seats while they are being installed and the nuts pulled up tight. Under no circumstances shall the disk be taken out or the gates taken apart to be installed. The joint between the thimble and frame shall be made up with a gasket of asbestos composition such as "Granite" made by the Crane Company or approved equal. The floorstands shall be firmly anchored to the concrete surface and shall be set so that the stem shall run smoothly in true alignment. Gates shall operate smoothly and close tightly without leakage.

b. Test. - The contractor shall lower and raise each gate at least three times, and shall make necessary adjustments in setting or installation required to secure satisfactory operation and tight closure of the gates. No separate payment will be made for testing and adjusting sluice gates.

19-11. TOOLS AND OPERATING INSTRUCTIONS. - The contractor shall furnish a complete set of all special tools needed for the adjustment, operation, and maintenance of the gates; five complete, bound manufacturer's lists of parts with necessary illustrations and references to permit convenient ordering of repair parts; and five found complete, clear, and concise sets of instructions for the operation, adjustment, lubrication and maintenance of the gates and the gate hoists.

19-12. GUARANTEE. - The following equipment to be furnished under this section of the specifications shall be guaranteed in accordance with the guarantee provisions set forth in the SPECIAL CONDITIONS:

Gate Frames
Gate Leaves
Gate Guides and Seats
Gate Stems
Floorstands
Wall Thimbles

19-13. PAYMENT. - No separate payment will be made for the work specified in this section, and all costs in connection therewith shall be included in the lump sum contract price for Item, "Mechanical Work - Pumping Station".

SECTION 20

TRAVELING CRANE
(Index)

SECTION 20

TRAVELING CRANE

20-01. SCOPE. - This section covers the furnishing and installation of one traveling crane, complete.

20-02. GENERAL DESCRIPTION. - The crane shall be hand operated and shall have a rated capacity of not less than 2 tons. The distance from center line to center line of crane rails and the high position of hook shall be as shown on the drawings.

20-03. DETAILED DESCRIPTION. - The crane shall consist essentially of a top running single girder bridge with a trolley hoist. Bridge shall be mounted on two trucks, each truck having two double-flanged wheels. The crane shall be geared for hand-chain-operation of the bridge travel, trolley travel, and hoist lift. The hoist shall be of the spur gear, army type integral with the trolley. The hoist shall be equipped with hoisting chain and shall provide for a vertical lift of 21 feet.

20-04. DESIGN. - All working parts shall be readily accessible for inspection and repair, properly designed and suitable for the use and service required. The design stress for any member or part of the material covered by these specifications shall not be greater than one-fifth of the ultimate strength of the material used.

20-05. DRAWINGS. - The contractor shall submit for approval, detailed drawings for the traveling crane he proposes to install, in sufficient detail to enable a check on the design. These drawings shall include a complete and itemized list of all parts, with the grade and class of material or make of a standard article, the contractor proposes to furnish. Thickness of plates and sizes of structural shapes must be shown either on the part or in the itemized list of parts. Any item or part needed to provide a complete and workable installation in accordance with the intent of these specifications shall be supplied by the contractor, whether or not it is included on the drawings, the list of parts, or in the requirements of these specifications.

20-06. MATERIALS AND WORKMANSHIP. - Materials used in the manufacture of the equipment shall be of the best quality used for the purpose in commercial practice. Workmanship shall be of the highest grade throughout and in accordance with the best standard practice for this type of equipment.

20-07. INSTALLATION. - The traveling crane shall be assembled and installed in the Pumping Station as shown on the drawings.

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20-08. INSPECTION AND TESTS. - After the crane has been erected, adjusted, lubricated, and otherwise made ready for operation, it shall be tested under the supervision of a person experienced in the installation, testing, and operation of the particular model of crane furnished. The bridge, trolley, and hoist shall be operated in each direction of travel for the full travel distance without load. The equipment shall be examined for misalignment, improper adjustment, and other possible defects. The tests will be repeated with the crane loaded at rated capacity. Tests will be made by and at the expense of the contractor.

20-09. CLEANING AND PAINTING. - Cleaning and painting shall conform to Section 27, "PAINTING".

20-10. GUARANTEE. - The traveling crane shall be guaranteed in accordance with the guarantee provisions of the Special Conditions.

20-11. PAYMENT. - No separate payment will be made for the work under this section and all costs in connection therewith shall be included in the lump sum price for Item Mechanical Work-Pumping Station. Furnishing and installation of rails, rail supports and brackets is included under the contract lump sum price for the "Pumping Station".

SECTION 21

WATER LINES, FIRE SUCTION LINES AND MISCELLANEOUS CAST IRON LINES

SECTION 21

WATER LINES, FIRE SUCTION LINES AND MISCELLANEOUS CAST IRON LINES

21-01. SCOPE. - This section covers the following features. -

a. Water service line to pumping station.

b. New 8-inch water lines replacing existing water lines.

c. Relocation of existing fire hydrants, including shed and additional 6-inch piping required.

d. Replacement of existing fire suction lines with 12-inch and 14-inch cast iron pipe, including post indicator valves, seep rings and relocation of existing foot falve.

e. Replacement of existing storm drain line with 12-inch cast iron pipe, including post indicator valve and seep rings.

21-02. EARTHWORK. - Excavation, trenching and backfilling is specified under the section, TRENCH EXCAVATION AND BACKFILLING FOR UNDERGROUND UTILITIES, of these specifications.

21-03. APPLICABLE SPECIFICATIONS. - The following specifications and standards, of the issues listed below but referred to thereafter by basic designation only, form a part of this specification.

a. Federal Specifications. -

O-C-114a	Calcium Hypochlorite Technical, and Chlorinated Lime, Technical.
O-S-602	Sodium Hypochlorite.
BB-C-120	Chlorine.
QQ-L-156 & Am-1	Lead, Calking.
SS-P-351a	Pipe, Asbestos-Cement.
WW-P-325	Pipe, Bends and Traps, Lead (for) Plumbing and Water Distribution.
WW-V-58 & Am-1	Valves, Cast-Iron, Gate; 125- and 250 Pound, Screwed and Flanged (for Land Use).

b. American Water Works Association Standards. -

C100-52	Cast Iron Pressure Fittings.
C500-52	Gate Valves for Ordinary Water Works Service.
C-502-53	Fire Hydrants for Ordinary Water Works Service.
C-601-54	Disinfecting Water Mains.

c. American Standards Association Standards. -

A21-2-1953	Cast-Iron Pit Cast Pipe for Water or Other Liquids.
A21.4-1953	Cement-Mortar Lining for Cast-Iron Pipe and Fittings.
A21.6-1953	Cast-Iron Pipe Centrifugally Cast in Metal Molds, for Water or Other Liquids.
A21.8-1953	Cast-Iron Pipe Centrifugally Cast in Sand-Lined Molds, for Water or Other Liquids.
A21.11-1953	Short-Body, Cast-Iron Fittings, 3-inch to 12-inch, for 250-psi, Water Pressure Plus Water Hammer.
A21.11-1953	Mechanical Joint for Cast-Iron Pressure Pipe and Fittings.

21-04. GENERAL REQUIREMENTS FOR MAINS AND BUILDING-SERVICE CONNECTIONS.- Piping for water mains and building-service connection may be any of the types and materials specified herein, except that pipe larger than 8-inches shall be cast iron pipe with mechanical joints. The pipe and accessories shall be new and unused unless otherwise approved by the Contracting Officer. The interior of the pipe shall be thoroughly cleaned of foreign matter before being lowered into the trench, and shall be kept clean during laying operations by plugging or other approved method. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells and joints. Any pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water, or when trench or weather conditions are unsuitable for the work, except by permission of the Contracting Officer. Water shall be kept out of the trench until the material in the joints has hardened, or until calking is completed. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Any section of pipe found to be defective before or after laying shall be replaced with sound pipe without additional expense to the Government. Where the location of the water pipe is not clearly defined by dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where bottom of water pipe will be at least 12 inches above top of sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity sewer lines the sewer shall be constructed of pressure pipe, for a distance of 10 feet each side of the crossing, with no joint located within 3 feet of the crossing or shall be fully encased in concrete. Fittings at bends in the pipeline shall be firmly wedged against the vertical face of the trench, as shown on the drawings or as directed by the Contracting Officer, to prevent the fittings from being blown off the lines when under pressure. Pipe ends left for future connections shall be valved, plugged or capped, and anchored, as shown on the drawings or as directed by the Contracting Officer. Where connections are made

between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions and taps shall be either wet or dry as directed.

21-05. CAST IRON PIPE. - a. Material. - (1) Cast-iron pipe shall conform to American Standard A21.2, A21.6, or A21.8, class 150, except that the pipe may be furnished with mechanical joints, or approved joints designed to lock rubber ring gaskets against displacement without calking. Pipe larger than 8-inches shall be provided with mechanical joints.

(2) Tests. - The pipe shall have been tested in accordance with Federal Specification WW-P-421, by the manufacturer.

(3) Cast-iron specials and fittings. - Specials and fittings shall be class D, conforming to the American Water Works Association Standard C100 or American Standard A21.10, unless otherwise specified.

(4) Joints shall be of the bell-and-spigot, mechanical, or bolted type. Jointing material shall conform to the following requirements:

(a) Bell-and-spigot joints. -

1. Joint packing. - Yarning or packing material shall consist of one of the following: molded or tubular rubber rings, asbestos rope, treated paper rope, hemp, or jute. The materials shall be handled with care in order to prevent contamination and shall be dry when put into place in the joint. The material shall be free of oil, tar, or grease. Hemp and jute shall be used only on Type II pipe conforing to Federal Specification WW-P-421 and shall be placed between the round rubber gasket and the bituminous joint compound as shown in figures 4 and 5 of the Federal Specification. Asbestos rope and treated paper rope may be used with type II pipe in lieu of hemp or jute. Rubber gasket may be used without calking where bell end of pipe locks gasket against displacement.

2. Calking lead shall conform to Federal Specification QQ-L-156, Type I.

(b) Mechanical joints shall be of the stuffing-box type and shall conform to American Standard A21.11.

(c) Bolted Joints. - Bolts, nuts and washers shall conform to the recommendations of the pipe manufacturer.

(5) Cement lining. - Pipe shall have cement lining conforming to Federal Specification WW-P-421. Specials and fittings shall have cement linings conforming to American Standard A21.4.

b. Installation. - (1) Handling. - Pipe and accessories shall be handled in such manner as to insure delivery to the trench in sound,

SECTION 28

TOPSOILING, SEEDING AND MULCHING

28-01. SCOPE. - This section covers topsoiling and seeding, complete.

28-02. MATERIALS. - a. Topsoil. - Topsoil shall be salvaged from areas within the limit of work in which excavation or grading is required. All other topsoil necessary to complete the work shall be furnished by the contractor from approved sources off the site at no additional cost to the Government. Topsoil to be provided by the contractor shall be natural fertile friable surface soil possessing the characteristics of representative soils in the vicinity that produce heavy growths of crops, grass, or other vegetation and shall be obtained from naturally well-drained areas. The topsoil shall be reasonably free from subsoil, clay lumps, brush, objectionable weeds and other litter. The topsoil shall be free from objects larger than 2 inches in any dimension, including stones, stumps, roots and debris, and shall not contain toxic substances or any other material or substance which might be harmful to plant growth or be a hindrance to grading, planting or maintenance operations. Delivery of off-site topsoil shall not begin prior to written approval from the Contracting Officer.

b. Fertilizer. - Fertilizer shall be complete 10-6-4 grade, and shall be uniform in composition, free flowing and suitable for application with approved equipment, delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable State Fertilizer laws, and bearing the name, trade name or trade mark, and warranty of the producer.

c. Lime. - Lime shall be ground limestone containing not less than 85 percent of total carbonates and shall be ground to such fineness that at least 50 percent will pass through a 100-mesh sieve and at least 90 percent will pass through a 20-mesh sieve. Coarser materials will be acceptable provided the specified rates of application are increased proportionately, on the basis of quantities passing the 100-mesh sieve, but no additional payment will be made for the increased quantity.

d. Seed. - All seed used shall be labeled in accordance with U. S. Department of Agriculture Rules and Regulations under the Federal Seed Act in effect on the date of Invitation for Bids. All seed shall be furnished in sealed standard containers, unless exception is granted in writing by the Contracting Officer. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable. The analysis of seed in each lot of mixture shall be as follows:

2. Lead-filled joints. - The depth of lead in lead-filled joints shall be not less than 2-1/4 inches back of the face of the bell. Lead shall be heated in a melting pot kept near the joint to be poured, brought to proper temperature, so that when stirred the surface will show a rapid change in color, and when poured into the joint space, will insure a perfect joint. Before lead is poured, scum shall be removed. The joint runner shall fit snugly against the face of the bell and the outside of the pipe and shall be dammed with clay at the pouring gate, to assure filling the joint even with the top of the bell. Each joint shall be made with one pour completely filling the joint space. The calking shall be done by competent mechanics, in such manner as to secure tight joints without overstraining the bells. The calking shall progress toward the joint gate. If the packing has been insufficiently calked, permitting the lead to be driven during calking to a depth more than 1/4 inch from the face of the bell at any point, the lead shall be removed and the joint remade.

(b) Mechanical joints shall be installed in strict accordance with the recommendations of the joint manufacturer.

(c) Bolted joints shall be made in strict accordance with the recommendations of the pipe manufacturer.

21-06. ASBESTOS-CEMENT PIPE. - (Option for 8-inch and smaller cast iron pipe).

a. Material. - (1) Pipe and couplings shall conform to Federal Specification SS-P-351, class 150, unless otherwise shown on the drawings or specified.

(2) Tests. - Each standard random or short length of pipe and each coupling sleeve when manufactured from the same material as the pipe shall be tested in accordance with Federal Specification SS-P-351.

(3) Specials and fittings shall be Class D, cast iron, as specified hereinbefore under cast-iron pipe, except that fittings shall have all bell connections of standard American Water Works Association dimensions, or special dimensions as required, or shall be equipped with adapters of the proper class for the size of pipe, as recommended by the manufacturer.

(4) Connections to cast-iron fittings. - Connections between asbestos-cement pipe and cast-iron pipe or with other materials recommended by the pipe manufacturer and approved by the Contracting Officer.

b. Installation. - Pipe, couplings, and fittings shall be handled and installed in accordance with the recommendations of the pipe manufacturer.

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21-07. TESTS FOR MAINS AND BUILDING-SERVICE CONNECTIONS. - After the pipe is laid, the joints completed, and the trench partially backfilled, leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise directed be subjected for 1 hour to a hydrostatic pressure test of 50 pounds per square inch in excess of the anticipated static pressure at the points of reading when the system is put in operation. Mains supplying water to individual buildings for fire protection shall be subjected for 2 hours to a hydrostatic pressure test of 200 pounds per square inch, or 50 pounds per square inch in excess of the maximum static pressure, whichever is greater. Exposed pipe, joints, fittings, valves, and hydrants shall be carefully examined during the open-trench test. Lead joints showing visible leakage shall be caulked until tight. Cracked or defective pipe, fittings, valves, or hydrants disclosed in the pressure tests shall be replaced by the contractor with sound material, and the test shall be repeated until the test results are satisfactory to the Contracting Officer. Where an actual visible inspection of each joint cannot be made because of the necessity for immediate backfilling or where the line is laid below water level and it is impracticable to lower the water level by pumping, or when the joints are made of other material than lead and the leakage diminishes as the material in the joints ages, suitable means shall be provided by the contractor for determining the quantity of water lost by leakage under normal operating pressure. No piping installation will be accepted until or unless this leakage (evaluated on a pressure basis of 150 pounds per square inch) is less than 100 U.S. gallons per 24 hours per mile of pipe per inch nominal diameter of pipe in 12-foot lengths, 75 gallons for pipe in 16-foot lengths, and proportionately varied for other lengths of pipe. In calculating leakage, the Contracting Officer will make allowance for added joints in the pipeline above the normal for unit lengths of pipe. Should any test of combined sections of pipeline disclose leakage greater per mile than that hereinbefore specified, or should individual sections show leakage greater than the specified limit, the contractor shall locate and repair the defective joints until the leakage is within the specified limits. Pipelines jointed with lead may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Before the replacement of permanent paving, and not less than 30 nor more than 40 days after the pressure test, a measured leakage test of the entire pipeline may be required at the discretion of the Contracting Officer. Leakage loss shall be within the allowances hereinbefore specified.

21-08. SERVICE LINES. - Unless otherwise shown on the drawings or specified, all service lines less than 3 inches in diameter shall be constructed of copper tubing. All pipe and fittings used in the construction of service lines shall conform to the applicable requirements for water mains. Service shall include the lines to, and connections with,

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with the building service at a point approximately 5 feet outside the building where such building service exists. Where building services are not installed, the contractor shall terminate the service approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with suitable plugs or caps. All service stops and gate valves shall be provided with extension service boxes of the lengths required by the depths of service-line stops or valves. Service lines shall be constructed in accordance with the following requirements.

a. Service Lines 1-1/2 inches and smaller shall be connected to the main by a corporation-type stop and a lead or copper gooseneck, with a service stop below the frostline.

b. Miscellaneous Items. - (1) Corporation stops shall have water-works standard thread on the inlet end, with flanged joint couplings or wiped joints for connections to goosenecks.

(2) Goosenecks. - Lead pipe for gooseneck connections shall conform to the applicable requirements of Federal Specification WW-P-325, class 100. Copper tubing for gooseneck connections shall conform to the applicable requirements of Federal Specification WW-T-799, type K, annealed. Length of connections shall be in accordance with standard practice.

(3) Service stops shall be water-works ground-key type, oval flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of cast-red brass having a nominal composition of 85 percent copper, 5 percent tin, 5 percent lead, and 5 percent zinc, with female iron-pipe-size connections and shall be designed for a minimum hydraulic test pressure of 200 pounds per square inch.

(4) Service boxes shall be of cast iron. Extension service boxes of the required length and having either screw- or slide-type adjustment shall be installed at all service box locations. The boxes shall have housings of sufficient size to completely cover the service stop and shall be complete with identifying covers.

21-09. GATE VALVES (NEW) shall be designed for a minimum water working pressure of not less than 150 pounds per square inch. Valves shall have bell or spigot ends or screw joints as required for the piping in which they are installed. Gate valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening. Each valve shall have the maker's initials, pressure rating and year of manufacture cast on the body. Prior to shipment from the factory, each valve shall be tested by hydraulic pressure equal to twice the specified water working pressure.

a. Valves 2 inches and larger shall be iron-body, brass-mounted, and shall conform to the American Water Works Association Standard C500 or to Federal Specification WW-V-58, class A.

21-10. INDICATOR POSTS shall be cast iron and shall be furnished as a unit with the gate valve. The indicator post shall have an operation unit 1-1/4 inches square and shall be fitted with a hasp and an approved cast bronze padlock in such a manner that the valve may be locked in open position only. Indicator posts shall be in accordance with the manufacturer's recommendations.

21-11. SETTING VALVES, VALVE BOXES, AND FIRE HYDRANTS, (NEW AND RELOCATED). - Valves, valve boxes, and fire hydrants shall be installed where shown on the drawings and directed by the Contracting Officer, and shall be set plumb. Valve boxes shall be centered on the valves. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet. Fire hydrants shall be set at such elevations that the connecting pipe will not have less cover than the distributing mains. The hydrant shall be set upon a slab of stone or concrete not less than 4 inches thick and 15 inches square. The back of the hydrant, opposite the pipe connection, shall be firmly wedged against the vertical face of the trench to prevent the hydrant from blowing off the line. If the character of the soil is such that in the opinion of the Contracting Officer the hydrant cannot be securely wedged, bridle rods and rod collars of not less than 3/4-inch stock protected by a coat of acid-resisting paint shall be used. Not less than 7 cubic feet of broken stone shall be placed around the base of the hydrant to insure drainage. The backfill around hydrants shall be thoroughly compacted to the gradeline in a manner satisfactory to the Contracting Officer. Hydrants and valves shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and the hydrant or valve shall be inspected in opened and closed positions to insure that all parts are in working condition. Valve boxes located in roads or sidewalks shall be protected by a concrete slab 24" x 24" x 6".

21-12. STERILIZATION. - The service line to the pumping station shall be sterilized with chlorine before acceptance for domestic operation.

a. Material. - (1) Liquid Chlorine shall conform to Federal Specification BB-C-120.

(2) Hypochlorite shall conform to Federal Specification O-C-114, type II, grade B, or Federal Specification O-S-602.

b. Method. - Sterilization shall be accomplished as described below or by the system prescribed by the American Water Works Association Standard C601 as determined by the Contracting Officer. The amount of chlorine applied shall be such as to provide a dosage of not less than 50 parts per million. The chlorinating material shall be introduced to the waterlines and distribution systems in a manner approved by the Contracting Officer. If possible to do so, the lines shall be thoroughly flushed before introduction of the chlorinating materials. After a contact period of not less than 8 and preferably 24 hours, the system shall be flushed with clean water until the residual chlorine content is not greater than 1.0 part per million. All valves in the lines being sterilized shall be opened and closed several times during the contact period.

21-13. EXISTING FOOT VALVES shall be carefully removed from the existing intake well and reinstalled in the new intake wells. Valves must be installed in a vertical position.

21-14. SEEP RINGS shall be installed on all utility lines which are to remain under the dike or wall as indicated on the drawings. Concrete shall be as specified in Section, CONCRETE.

21-15. EXISTING HYDRANT SHED. - The existing wood hydrant shed, where indicated on the drawings, shall be relocated with the existing hydrant and set in the same relative position, with respect to the hydrant, as now exists.

21-16. CLEAN-UP. - Upon completion of the installation of the water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

21-17. PAYMENT. - a. Water Service to Pumping Station. - No separate payment will be made for the water service line to the Pumping Station and all costs in connection therewith, including excavation, filling and backfilling and special fittings shall be included in the lump sum contract price for Item "Pumping Station".

b. Water Mains - 8-inch. - The length of the 8-inch mains to be paid for will be determined by measurement along the center line of the pipe furnished and installed from centerlines of existing mains. Payment will be made at the contract unit price per linear foot for Item "Pipe, Cast Iron-8-inch", which price shall be full compensation for all pipe, either cast iron or asbestos-cement, complete in place, including excavation, filling and backfilling and connections to existing mains.

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c. Relocation of Hydrants. - This item will be measured as one complete unit. Payment will be made at the contract lump sum price for Item "Relocation of Fire Hydrants", which price shall include excavation, filling and backfilling, relocation of existing hydrants, valves, and shed, and furnishing and installing all new pipe and incidental items required for complete installations.

d. Cast Iron Pipe-12- and 14-Inches. - The length of the pipe to be paid for will be determined by measurement along the centerline of the pipe furnished and installed. Payment will be made at the applicable contract unit price for linear foot for Items "Pipe, Cast Iron-12-Inch" and "Pipe, Cast Iron-14-Inch", which prices shall be full compensation for all pipe, complete in place, including excavation, filling and backfilling and connections to existing piping.

e. Post Indicator Valves. - Each post indicator valve, complete in place, in new or existing lines, will be measured as a complete unit. Payment will be made at the applicable contract unit prices each for Item "Post Indicator Valve" which prices shall include full compensation for valves complete in place.

f. Existing Foot Valves. - No separate payment will be made for the work specified in Paragraph 21-13 and all costs in connection therewith shall be included in the contract unit price for Item "Intake Structure".

g. Seep Rings. - Measurement and payment for concrete placed in Seep Rings will be made as specified in Section 10.

SECTION 22

MISCELLANEOUS ITEMS OF WORK
(INDEX)

SECTION 22

MISCELLANEOUS ITEMS OF WORK

22-01. SCOPE. - This section covers miscellaneous items of work.

22-02. REMOVAL OF EXISTING CURB. - The contractor shall be required to remove the existing curb in connection with the work in the vicinity of Mechanic Street to the levels shown or required in order to install the new work. All curb removed shall remain the property of others and shall be stored where directed. The contractor shall provide such new items of curb as necessary; such curb to match existing. Payment for all costs in connection with the above shall be included under "Preparation of Site".

22-03. ASPHALT PAVEMENT. - a. New Pavements. - The new 3" asphalt pavement placed over the base slabs for the vehicular street gates shall consist of a 1-1/2-inch surface course and a 1-1/2-inch binder course. Pavements adjacent thereto to replace removed sidewalks shall consist of a 1-1/2-inch surface course. Gravel for base course for new pavement shall be one course foundation of sand and gravel. Asphalt pavement shall conform to the requirements of Section 4.03, Class I, hot asphalt concrete pavement, and gravel base shall conform to Section 3.02 of the Standard Specifications for Roads, Bridges, and Incidental Construction of State Highway Department, State of Connecticut.

b. Existing Pavements. - All existing pavements removed by the contractor in order to install the new work shall be replaced as required. Repaired pavements, including base courses and subgrade preparation shall match existing adjacent pavement in all respects.

c. Payment. - Payment for all work included under subparagraph a. above will be included in the lump sum contract price for the applicable street gates. No separate payment will be made for the work included under subparagraph b. above and all costs in connection therewith shall be considered a subsidiary obligation of the contractor.

22-04. REPAIRS TO EXISTING ITEMS. - Any damage to existing structures or work of any kind, including pavements and grassed areas, or the interruption of a utility service resulting from the operation of the contractor shall be repaired or restored by and at the expense of the contractor. Except as otherwise specified, all costs in connection with the above shall be considered a subsidiary obligation of the contractor. All workmanship and materials shall be subject to approval. All permits and fees required due to the contractor's street opening activities shall be the responsibility of and by and at the expense of the contractor. Where concrete walks are removed to install new work in the vicinity of the street gates, the walks shall be replaced to meet the new indicated curbing.

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22-05. WATER LEVEL INDICATORS. - a. General. - The contractor shall install and adjust two water level indicators in the Pumping Station complete with piping and accessories as shown on the drawings or hereinafter specified.

b. River Level Gage. - The river level gage shall be a diaphragm type similar or approved equal to the liquid level gage, Figure A324 with diaphragm box, Figure 9617, type II, as shown in Bulletin 8-10 of the Foxboro Company of Foxboro, Massachusetts. The diaphragm shall be made of material suitable for use in sea water. The diaphragm box shall be made of acid-resisting bronze and shall be securely bracketed to the wall where indicated on the drawings. Bracket shall be arranged so that the diaphragm box may be removed for maintenance. The capillary tube connecting the diaphragm box to the gage shall be of copper, shall be installed where shown, and shall be protected from mechanical injury by means of type 'k' copper tubing. The gage shall be securely fastened to the wall of the pumping station by means of a suitable bracket. The dial shall be 6-inches in diameter graduated 0 to plus 20 feet. Dial shall be graduated to read directly in feet and in fourths of a foot. A suitable copper tubing sleeve (type 'k') shall be provided in the operating floor to allow passage of the tubing.

c. Station Sump Level Indicator. - The level indicator for the station sump shall be of the indicating dial type float gage. The float gage well shall be of 8-inch cement asbestos pipe conforming to the requirements of Federal Specification SS-P-351a., class 150. The pipe shall be fastened securely to the sump wall and shall be installed plumb and true at the location and in the manner shown on the drawings. The float, tape, and counterweight shall be made of corrosion-resisting metal. The dial shall be 6-inches in diameter and graduated from minus 2 to plus 4 feet. Dial shall be graduated to read directly in feet and in fourths of a foot. The equipment shall be similar or approved equal to the float and cable type indicator, Figure 9622, (non-recorder) as shown in Bulletin 8-10 of the Foxboro Company of Foxboro, Massachusetts, modified to operate with an 8-inch float well.

d. Guaranty. - The water level indicators shall be guaranteed in accordance with the guarantee provisions of the Special Conditions.

e. Payment. - No separate payment will be made for the work specified in this paragraph and all costs in connection therewith shall be included in the lump sum contract price for Item "Pumping Station".

SECTION 23

WORK IN BUILDINGS 2 and 5
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SECTION 23

WORK IN BUILDINGS 2 and 5

23-01. SCOPE. - This section includes all work required or indicated within buildings 2 and 5, complete.

23-02. ACCESS TO WORK AREAS. - a. The access with Buildings 2 and 5 will be as directed by the Contracting Officer. The contractor shall notify the Contracting Officer in writing, 30 days in advance of the time he proposes to work within the buildings. The contractor will be restricted as to the size of equipment he will be permitted to use.

b. Care shall be taken so as to interefere with building operations as little as possible. The contractor shall make all necessary arrangements with the owner relative to his operations within the buildings.

23-03. EXCAVATION. - Excavation shall conform to the applicable requirements of Section 3. Care shall be taken not to over-excavate and all material over-excavated shall be replaced with filter sand.

23-04. CONCRETE. - Concrete for construction of sump pit, and for repair or replacement of concrete floors or other structures due to overrutting or damage by the contractor shall conform to applicable requirements of Section 10. Cutting of concrete shall be performed using saws of the proper type and size.

23-05. RELIEF DRAINS. - Furnishing and installation of perforated relief drains, including filter sand and stone shall conform to the applicable requirements of Section 6.

23-06. PORTABLE SELF-PRIMING CENTERIFUGAL PUMPS. - The contractor shall provide a portable pump in buildings 2 and 5 where directed.

a. Description. - Each unit shall consist of a self-priming pump, gasoline engine and all necessary accessories and connections. The unit shall be pushcart mounted, and shall be compact and self contained. The unit shall be designed and constructed to withstand hard usage, storage and operation in the open air under all weather conditions for extended periods of time and operations when positioned 15° from level. Components, particularly of the electrical fuel and exhaust systems shall be designed to resist dust and corrosion. The units shall be stored where directed.

b. Base of Maintenance. - The units shall be designed to permit ready accessibility to all parts for maintenance and repair in the field utilizing conventional tools associated with items of this nature. The

replacement and adjustment of parts shall be accomplished with minimum drainage requirements and without disturbance to other components of the unit. Cover plates which need to be removed for unit adjustment or repair shall be equipped with substantial quick disconnect fastenings.

c. Safety. - All rotating parts or reciprocating parts and parts subject to high temperatures, that are of such nature or so located as to become a hazard to operating personnel, shall be insulated fully enclosed or properly guarded.

d. Pump. - The pump shall be of the centrifugal self priming type. The pump shall deliver 200 gpm of water against a total head including friction of 30 feet when the height of the pump is 10 feet above the water.

e. Pump Case. - The pump case shall be of cast-iron conforming to Federal Specification QQ-I-652a, Class 40, or higher, stress relief annealed; or hot rolled steel.

f. Engine. - The engine shall conform to Specification MIL-E-11275c. The power and speed rating shall be such that operation of the pump at rated power requirement conditions will not require horsepower in excess of continuous brake horsepower rating of the engine.

g. Fuel Tank. - The fuel tank shall have a minimum capacity for 4 hours of continuous operation.

h. Governor. - A centrifugal-type governor, gear driven from the engine, shall be provided. The governor shall maintain constant speed within plus or minus one percent when operating the pump at rated capacity and shall not permit the engine speed, under any of the operating conditions, to exceed 10 percent of the full-load governed speed.

i. Pushcart. - The pushcart shall consist of a structural steel base, an axle, 2 pneumatic tired wheels, a push bar, and a steel support leg to hold the car horizontal when stationary. The base shall be welded into a rigid support for the engine and pump. The pumping unit shall be mounted in a balanced position over the axle and shall be bolted to the base. The push bar and support leg shall be bolted to the base.

j. Suction Hose. - Suction hose for each unit shall conform to Federal Specification ZZ-H-561d, Type I, 4-inch diameter, 10 feet in length. The hose shall be equipped with a sump-type foot valve with a strainer having a total area of not less than eight times the effective entrance area of the foot valve. The hose shall be equipped with nipples. Clamps shall not be used. Flanges conforming to Federal Specification WW-F-406a shall be provided. Threads shall be American standard taper pipe threads.

k. Discharge Hose. - Discharge hose shall conform to Federal Specification ZZ-H-451a, double jacket 4 inches in diameter, 15 feet in length, shall be provided for one pump and 30 feet in length shall be provided for other pump. The hose couplings shall be type B-2 except that threads shall be American Standard straight pipe threads.

l. Nipples. - The pump shall be equipped with a nipple for the suction port and a nipple for the discharge port and shall conform to Federal Specification WW-N-351a, Type I, 6 inches in length, diameter as required.

m. Lubrication. - All moving parts shall be provided with suitable means of lubrication.

n. Initial Lubrication Service. - The equipment shall be serviced before delivery to the storage area, with winter grades of standard Military lubricants designed for use in temperature range of 0°F to plus 32°F. After the lubrication service, each item of equipment shall be tagged in a conspicuous place to indicate the temperature range and grade of lubricants used.

o. Lifting Attachment. - The equipment shall be provided with suitable lifting attachments to enable the equipment to be lifted in its normal position. The eye of each lifting attachment shall not be less than 3 inches in diameter.

p. Treatment and Painting. - All parts of the equipment normally painted in good commercial practice shall be treated and painted in accordance with Military Specification MIL-T-704C, Type A, except that electrical equipment, the engine and parts subject to high temperature shall be painted in accordance with standard practice of the manufacturer.

q. Workmanship. - Workmanship shall be of the highest grade throughout and in accordance with good commercial practice for this type of equipment.

r. Guarantee. - The units shall be guaranteed in accordance with the guarantee provisions of the Special Conditions.

23-07. SUMP PIT. - The contractor shall construct a new sump pit in Building 5 where indicated.

a. Metal work shall conform to the applicable requirements of Sections 25 and 26. Metal gratings shall conform to the drawing details and to the requirements of Federal Specification RR-G-661a. Edges of all gratings shall be banded, and all gratings shall be hot galvanized to conform to Federal Specification QQ-I-716, Class C. Frames shall be of standard steel angles and shall be all-welded construction, and galvanized to match grating. Frames shall be provided with welded-on anchors.

R

23-08. PAYMENT. - Payment for all work specified in this section will be made at the applicable lump sum contract prices for Items "Work in Building No. 2" and "Work in Building No. 5", which price shall include all costs in connection with excavation, concrete work, including reinforcing steel and cement, relief drains, filter sand and stone, connection to existing sump, and portable pumps.

SECTION 24

INTAKE STRUCTURES
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SECTION 24

INTAKE STRUCTURES

24-01. SCOPE. - This section covers the new intake structures including timber gates, ladder rungs, and access covers and frames and relocation of existing foot valves, to new locations, complete.

24-02. WORK NOT INCLUDED. - a. The removal of the existing sump well, 30-inch pipe, and timber bulkhead shall be included under Section 1, "Preparation of Site."

b. The control and diversion of water shall be as specified under Section 2, "Control and Diversion of Water."

24-03. EXCAVATION. - Excavation shall conform to the requirements of Section 3.

24-04. CONCRETE. - Concrete shall conform to the requirements of Section 10, "Concrete".

24-05. TIMBER GATE. - A timber gate conforming to all the details shown on the drawings shall be furnished and installed in each new intake well. It shall be constructed of pressure treated lumber as specified for stop logs under Section 11 with structural steel shapes and hoisting plates of the size and dimensions shown. Nuts and bolts for joining the timbers together shall be bronze. Structural steel shall be painted as specified in Section 27. After gate has been installed and demonstrated to operate properly, the gate shall be removed and stored where directed.

24-06. METAL WORK. - The ladder rungs, access covers and frames, and other metal work shall conform to the requirements of Sections 25 and 26 and as indicated on the drawings.

24-07. FOOT VALVES.-Foot valves shall be relocated as specified under Section 21.

24-08. PAYMENT. - a. Payment for each intake structure as specified in this section, except as otherwise described below, will be made at the contract price for Item, "Intake Structure".

b. Concrete, cement and reinforcing steel will be paid for separately as specified in Section 10.

c. Excavation will be paid for separately as specified under Section 3 at the contract unit price for Item No. 3.

d. Payment for removal of existing sump well, 30-inch pipe and timber bulkhead will be included under the lump sum price for Item 1, "Preparation of Site".

e. Payment for all costs in connection with control and diversion of water will be included under Item 2, "Control and Diversion of Water".

SECTION 25

METALS, MISCELLANEOUS MATERIALS AND STANDARD ARTICLES

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SECTION 25

METALS, MISCELLANEOUS MATERIALS AND STANDARD ARTICLES

25-01. STANDARD SPECIFICATIONS. - a. Standard specifications of the following listed authorities whenever cited herein are referred to by use of the abbreviations shown below.

NAME	ABBREVIATION
Federal Specifications	Fed. Spec.
Military Specifications	MIL or JAN
U. S. Army Engineer Waterways Experiment Station P.O. Box 631, Vicksburg, Mississippi	CRD-C
American Society for Testion Materials 1916 Race Street Philadelphia 3, Pennsylvania	ASTM

b. Reference copies of specifications published by agencies of the Department of Defense are on file in the Office of the Contracting Officer, and may be viewed by interested parties upon request. Copies of Fed. Specs, may be obtained at nominal cost by writing to the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Copies of the specifications of other listed authorities may be purchased by writing directly to such organizations at the addresses shown above.

c. In the paragraphs below, each metal, miscellaneous material or standard article is followed by the number and title of the specification, to which the item is required to conform.

25-02. STRUCTURAL STEEL. - a. Federal Specification QQ-S-741a, "Steel Plates, Shapes and Bars, Carbon, Structural", Type I or II (as specified or as shown on the drawings), Class 1. Wherever Type I steel is required, Type II steel will also be acceptable.

b. Requirements in Federal Specification QQ-S-741a, paragraph 3.6 for identification marking are waived for Type I structural steel. Identification marking of type will be required whenever Type II steel is required except when certified mill reports are furnished, in which case requirements for such marking will be waived.

c. The contractor may, at his option, furnish steel conforming to ASTM A7-58T, Specifications for "Steel for Bridges and Buildings" when steel conforming to QQ-S-741a, Type I, is indicated or specified; also he may, at his option, furnish steel conforming to ASTM A373-58T, Specifications for "Structural Steel for Welding" when steel conforming to QQ-S-741a, Type II, is specified or indicated.

d. The contractor may, at his option, furnish steel conforming to ASTM A36-60T in lieu of steel conforming to QQ-S-741a, Type I or II. Identification marking of type will be required whenever steel conforming to ASTM A36-60T is provided except when certified mill reports are furnished, in which case requirements for such marking will be waived.

25-03. STEEL, CONCRETE REINFORCEMENT. - Specified and included under section "CONCRETE".

25-04. STEEL FORGINGS. - ASTM A235-55, Specifications for "Carbon Steel Forgings for General Industrial Use", Class as required.

25-05. STEEL CASTINGS. - Federal Specification QQ-S-00681c, "Steel; Castings," Class as required.

25-06. BRONZE. - a. Castings. - Federal Specification QQ-L-225, "Leaded Tin Bronze Castings and High Leaded Tin Bronze Castings," Composition 6.

b. Manganese Bronze Castings. - Federal Specification QQ-B-726d, "Bronze, Manganese and Aluminum-Manganese, Castings."

c. Rolled Manganese Bronze and Maganese Bronze Forgings - Federal Specification QQ-M-80, "Manganese Bronze Bars, Plates, Rods, Sheets, Strips, Flat Wire, Forgings, and Structural and Special Shaped Sections," Class A, temper half-hard.

25-07. BRASS. - a. Sheets, Plates and Bars. - Federal Specification QQ-B-613b, "Brass, Leaded and Non-leaded; Flat Products (Plate, Bar, Sheet and Strip)."

b. Castings. - Federal Specification QQ-B-621b, "Brass; Castings, Leaded Yellow," Class B.

c. Naval Brass. - Federal Specification QQ-B-637, "Brass, Naval: Rod, Wire, Shapes, Forgings and Flat Products with Finished Edges (Bar, Flat Wire, and Strip)." All brass shall be of this material except as otherwise specified.

25-08. COPPER. - Federal Specification QQ-C-576b, Temper as required.

25-09. SHEET LEAD. - Federal Specification QQ-L-201d, "Lead, Sheet," Grade B.

25-10. ZINC. - Federal Specification QQ-Z-351a, "Zinc, Slab (Spelter)," Grade 2.

25-11. BABBITT METAL. - Federal Specification QQ-T-390, "Tin Alloy Ingots and Castings and Lead Alloy Ingots and Castings (Antifriction Metal) for Bearing Applications," Grade 3.

25-12. SPRING STEEL. - Spring steel shall conform to ASTM A 59-49 or AISI 9255 or 9260 (oil quenched).

25-13. GRAY IRON ALLOY CASTINGS (SCALE RESISTING). -Scale resisting gray iron castings (high-nickel-alloy cast-iron) shall conform to Military Specification MIL-G-858A with Amendment 2, Class 1, except as otherwise specified or indicated.

25-14. COLD-ROLLED STEEL. - ASTM Designation A 108-58T for "Cold-finished Carbon-Steel Bar and Shafting." Unless otherwise specified, this material shall be used for rods, pins, keys and similar parts.

25-15. STEEL, CORROSION RESISTING. - Federal Specification QQ-S-766c class as required in accordance with Paragraph 6.

25-16. IRON CASTINGS. - Federal Specification QQ-I-652a, for "Iron Castings, Gray", class as indicated or specified. Tensile tests and chemical analysis will not be required.

25-17. MALLEABLE IRON CASTINGS. - Federal Specification QQ-I-666c, "Iron Castings, Malleable", Class A.

25-18. MALLEABLE IRON FITTINGS. - Federal Specification WW-P-521c, for "Pipe Fittings; Malleable-Iron (Screwed), 150-pound."

25-19. HIGH-STRENGTH BOLTS, NUTS AND WASHERS. - The material for high-strength bolts, nuts and washers shall conform to ASTM Standard A 325-58T. Bolt and nut dimensions and threads shall be in accordance with American Standard B18.2 for regular semi-finished hexagon bolts and heavy semi-finished hexagon nuts.

25-20. STEEL BOLTS.- Federal Specification FF-B-571a, "Bolts; Nuts; Studs; and Tap Rivets (and Material for same)". Unless otherwise specified, steel for bolts shall be Class B and steel for nuts shall be Class C. Bolts and studs for work in connection with the Vehicular Strut Gates shall be Type B, hexagonal head, finished; nuts shall be Type A, hexagonal, finished regular; threads shall be Class 3 medium fit in the nuts as established by the National Screw Thread Commission. Bolts and studs for all other work shall be Type A, hex head, unfinished; nuts shall be Type B, hex, unfinished; threads shall be Class 2 fit in the nuts as established by the National Screw Thread Commission. A steel washer of the required thickness shall be furnished with each nut.

25-21. CORROSION-RESISTING STEEL PINS AND BOLTS. - Corrosion-resisting steel bolts, studs, nuts, washers, pins for vehicular gate hinges, bars and shapes shall conform to Federal Specification QQ-S-763b, "Steel Bars, Shapes, and Forgings, Corrosion-Resisting Steel", Condition A, Class 304, and to the applicable requirements of Paragraph, "STEEL BOLTS" above.

25-22. HOT-ROLLED STEEL. - ASTM Designation A 107-59T for "Hot-rolled Carbon-Steel Bars". Unless otherwise specified, this material shall be used for rods, pins, key stems for locking device of vehicular gate, and similar parts.

25-23. ZINC-COATED SHEET STEEL. - Zinc-coated sheet steel shall conform to Federal Specification QQ-S-775a, type I, Class d. Zinc-coated sheets shall be applied in as large sections as practicable.

25-24. SELF-LUBRICATING BRONZE BUSHINGS (VEHICULAR GATES). - The self-lubricating bronze bushings for the top and bottom anchorage bearings, of the Vehicular Street Gate shall be articles of standard production by an established manufacturer of the equipment specified. The bearings shall be completely self-lubricating and require no additional or supplementary lubrication for the entire service life of the bearings. The bearings shall be provided with special recesses arranged in a uniform, geometric and overlapping pattern and of the sizes to give optimum lubricating coverage and service for the specific conditions under which each bearing is to be used, as recommended by the bearing manufacturer and as approved. The recesses shall be filled with a lubricating compound capable of withstanding the atmospheric elements, temperature and the operating conditions for service both dry and submerged. The lubricating compound shall consist of metals, metallic oxides, graphite and other lubricating materials combined with a lubricating binder. All ingredients must have inherent and native lubricating qualities. The lubricating compound shall be compressed into the recesses of the bearing metal by hydraulic pressure so as to form dense, non-plastic lubricating inserts. The lubricating area shall comprise not less than 30 percent of the total bearing surface area. Unless otherwise indicated or specified, bearing metal shall be bronze conforming to Federal Specification QQ-L-225, "Leaded Tin Bronze Castings and High Leaded Tin Bronze Castings" composition 16. Bushings shall not be reamed after the lubricating compound has been placed in the bearing. The coefficient of friction shall not exceed 0.10. The contractor shall submit to the Contracting Officer for approval, the bearing manufacturer's printed recommendations for the bronze bearing metal; the pattern, size and spacing of lubricant inserts for each bearing application for the specific conditions under which it will be used.

25-25. SOLDER. - Federal Specification QQ-S-571c, "Composition SN50".

25-26. NICKEL-COPPER ALLOY. - Nickel-copper alloy (r-monel) metal shall conform to Federal Specification QQ-N-281a, class B; "Nickel-Copper-Alloy (Monel and R-Monel) Bars, Plates, Rods, Sheets, Strips, Wire, Forgings and Structural and Special Shaped Sections".

25-27. NON-METALLIC WATERSTOPS. - Waterstops may be composed of natural rubber, a suitable synthetic rubber, a blend of natural and

synthetic rubber, or of polyvinylchloride. Rubber waterstops shall comply with the requirements of CRD-C 513-60, "Corps of Engineers Specifications for Rubber Waterstops." Polyvinylchloride waterstops shall conform to the requirements of CRD-C 572-61, "Corps of Engineers Specifications for Polyvinylchloride Waterstops."

25-28. RUBBER GATE SEALS. - The material for gate seals including vehicular gates shall be compounded of natural rubber containing only carbon black, zinc oxide, accelerators, vulcanizing agents, antioxidants, copper inhibitors and plasticizers. Physical characteristics shall meet the following requirement:

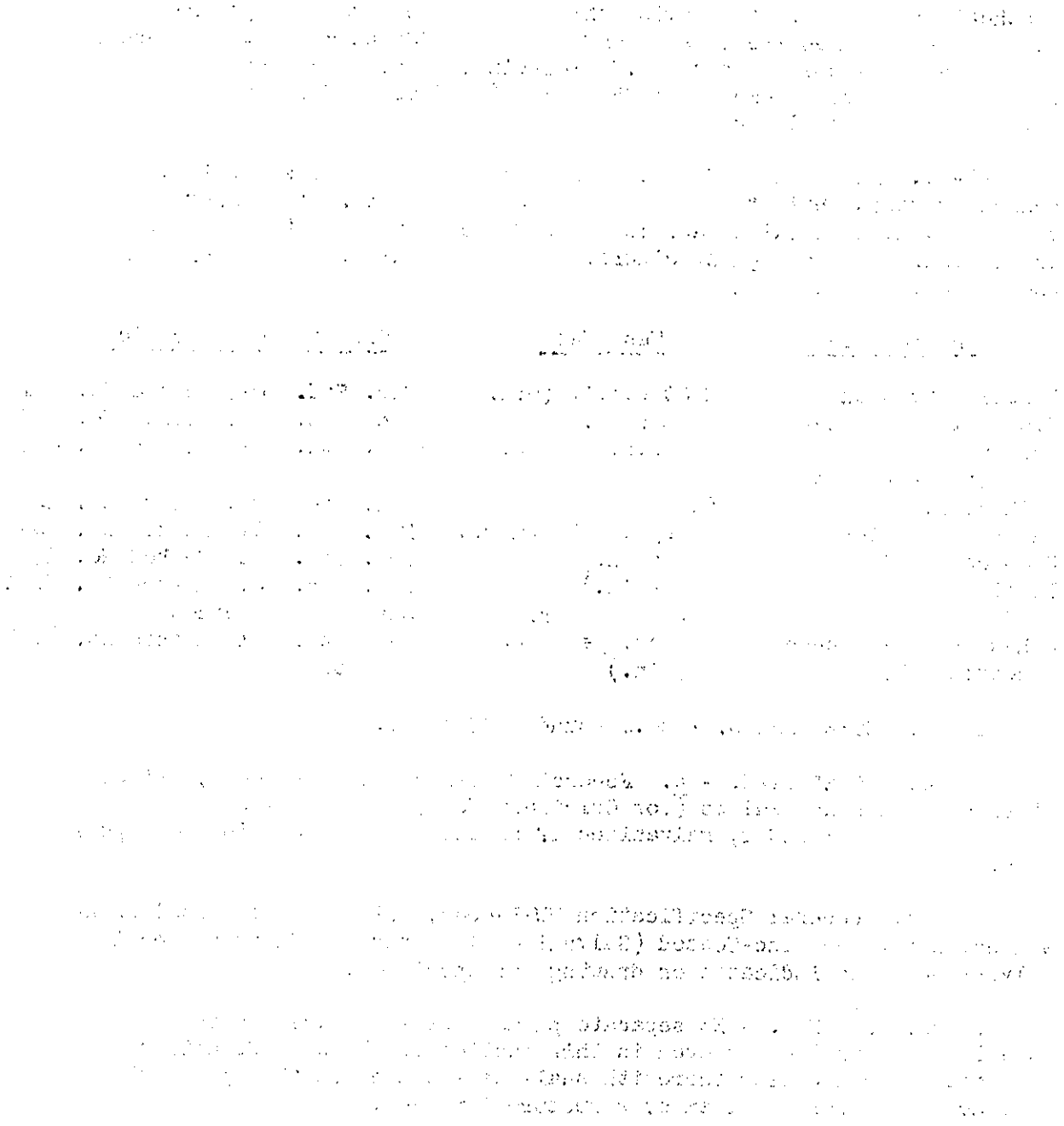
Physical Test	Test Value	Test Method Specification
Tensile Strength	2500 p.s.i. (min.)	Fed. Std. 601, Method No. 4111
Elongation at break	450% (min.)	Fed. Std. 601, Method No. 4121
300% modulus	900 p.s.i. (min.)	Fed. Std. 601, Method No. 4131
Durometer Hardness Shore Type A	60 to 70	Fed. Std. 601, Method No. 3021
Water Absorption	5% by weight (max.)	Fed. Std. 601, Method No. 6631
Compression Set	30% (max.)	Fed. Std. 601, Method No. 3311
Tensile Strength after aging	80% (min.) of tensile strength	Fed. Std. 601, Method No. 7111 Oxygen bomb method
Adhesion on 18 ounce cotton fabric	18 lbs. per inch (min.)	Fed. Std. 601, Method No. 8011 or 8021

25-29. STEEL RAILS. - 30.1 pound ASCE rails.

25-30. STEEL PIPE. - a. Federal Specification WW-P-406a, "Pipe, Steel (Seamless and Welded (for Oridinary Use))," Weight A and B as required, Class 1 and 2, galvanized if so indicated on drawings or specified.

b. Federal Specification WW-P-404c, "Pipe; Steel (Seamless and Welded, Black and Zinc-Coated (Galvanized))," Grade A, Class as required, galvanized if so indicated on drawings or specified.

25-31. PAYMENT. - No separate payment will be made for the work, materials or supplies covered in this section of the specifications and all costs in connection therewith shall be included in the applicable contract price for the item or structure involved.



SECTION 26

METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS
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SECTION 26

METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS

26-01. SCOPE.- This section specifies the workmanship standards applicable to the various phases of metalwork fabrication, the methods and precautions for erection of metal structures and machines, the general requirements for tests and trials on such structures and machines to insure conformance with the specifications, and miscellaneous requirements incident to the work.

26-02. WORKMANSHIP. - a. General. - Material shall be thoroughly straightened by methods that will not result in injury, except that sharp kinks or bends in members to be straightened will be cause for rejection. Finished members shall be free from kinks, bends, or winds. Shearing shall be accurately done, and all portions of the work neatly finished. Corners shall be square and true unless otherwise shown on the drawings. Re-entrant cuts shall be made in a workmanlike manner and, where they cannot be made by shearing, a rectangular punch may be used. Re-entrant cuts shall be filleted unless otherwise approved by the Contracting Officer. Bends, except for minor details, shall be made by approved dies or bending rolls. Where heating is required, precautions shall be taken to avoid overheating the metal and it shall be allowed to cool in such a manner as not to destroy the original properties of the metal. Steel with welds will not be accepted, except where welding is definitely specified, called for on the drawings or otherwise approved. All bolts, nuts, and screws shall be tight. The ends of pipe, except for handrailing, shall be reamed.

b. Dimensional Tolerances for Structural Work. - (1) Dimensions shall be measured by means of an approved calibrated steel tape of the same temperature as the structure at the time of measurement. Unfairness of platework shall be held to a practicable minimum.

(2) An allowable variation of 1/32 inch is permissible in the over-all length of members with both ends milled. Members without milled ends, which are to be assembled to other steel parts of the structure, shall not deviate from the dimensions shown on the drawings by more than 1/16 inch for members 30 feet or less in length, and by not more than 1/8 inch for members over 30 feet in length.

26-03. WELDING. - a. General. - Unless otherwise authorized or specified, welding shall be by the electric arc-welding process, using a method which excludes the atmosphere from the molten metal. Welding, unless specified otherwise, shall conform to the applicable provisions of the current AWS "Specification for Welded Highway and Railway Bridges". Welding operators, including tack welders and machine welders, and machines

shall be qualified, and as necessary requalified, for the particular type of work to be done, as required by the American Welding Society "Tentative Standard Qualification Procedure", the U.S. Navy Department "General Specifications for Inspection of Material", Appendix VII, "Welding", the U.S. Coast Guard "Marine Engineering Regulations and Material Specifications", or by Section IX of the "ASME Boiler and Pressure Vessel Code". The contractor shall certify by name, to the Contracting Officer, the welding operators so qualified, and the code under which qualified. The contractor shall require any welded to repeat the qualifying tests when, in the opinion of the Contracting Officer, the work of the welder indicates a reasonable doubt as to his efficiency. In such cases, the welder shall be recertified, as above, if he successfully passes the retest; otherwise he shall be disqualified until he has successfully passed a retest. Welding, except light caulk welding, will not be permitted in combination with riveting in the same joint. All expenses in connection with qualification and requalification shall be borne by the contractor.

b. Inspection. - Welding shall be subject to inspection by Government inspectors in conformance with the applicable inspection requirements of Paragraph 26-03a. The Contracting Officer may also require coupons to be cut from any location in any joint for testing. All sections of welds found defective shall be chipped or cut out to base metal and properly rewelded before proceeding with the work. Should any two coupons cut from the work of any welder show strengths, under test, less than that of the base metal, it will be considered evidence of negligence or incompetence and such welder shall be permanently removed from the work. When coupons are removed from any part of a structure, the members cut shall be repaired, at the expense of the contractor, in a neat and workmanlike manner with joints of proper type to develop the full strength of the members and joints cut, with peening as necessary or directed to relieve residual stress.

c. Welding Equipment. - Manual and automatic arc-welding machines and equipment may be of either the alternating current or direct current type and shall conform to the requirements for arc-welding equipment as set forth in the AWS "Specifications for Welded Highway and Railway Bridges".

d. Filler Metal. - (1) Unless otherwise specified or authorized, all deposited weld metal shall have elastic limits and ultimate tensile strengths not less than those specified for the respective base metals welded; shall have an elongation in 2 inches, using annealed samples, of at least 95 percent of the value specified for the base metal or at least 75 percent using unannealed samples; chemical composition similar to that of the base metal; and, when subjected to approved tests, shall have corrosion resistance at least equivalent to that of the base metal. These

properties shall be determined by testing in accordance with the applicable provisions of the AWS specifications, or as otherwise approved by the Contracting Officer.

(2) Welding electrodes and rods shall be of a type and grade approved by the Contracting Officer; of such chemical composition and physical properties as will produce the characteristics specified above; and so adapted to the base metal and thickness of parts to be welded as will insure effective penetration and an intimate uniform fusion of the filler and base metals, in all welding positions and under all conditions to be encountered, without undercutting or overlapping. The electrodes shall conform to applicable provisions of the ASTM specifications.

e. Special Workmanship Requirements. - (1) Welding procedure. - The contractor shall prepare a schedule of welding procedure for each structure to be welded, including any stress-relief annealing, and shall submit the schedules for approval in accordance with the requirements of SC-4, "Shop Drawings". The procedures shall be in accordance with the best modern welding practice, and shall be such as to minimize residual stresses and distortion of the finished members of the structure. Should it be found that changes in any previously approved welding procedure are desirable, the Contracting Officer will direct or authorize the contractor to make such changes. Approval of any procedure, however, will not relieve the contractor of the sole responsibility for producing a finished structure meeting all requirements of these specifications.

(2) Stress-relief Annealing. - Where stress-relief annealing is specified or required on the drawings it shall be in accordance with the requirements of paragraph 512 of the AWS "Specification for Welded Highway and Railway Bridges", unless otherwise authorized or directed by the Contracting Officer.

(3) Welds. - Assembly of all welded joints before welding shall be such as to secure specified root openings. The maximum length of bead laid in any one continuous or skip pass shall be that which can be laid with one electrode. Unless otherwise specifically authorized, all welds shall be of the type, size, and dimensions as shown on the drawings. Welds 3/8 inch and larger shall be made in not less than 2 passes; and, unless otherwise specified or authorized, shall be made with one pass for each 3/16 inch of the maximum thickness of the weld metal, exclusive of back bead. Welds for watertight work shall be continuous and made in not less than 2 passes for butt joints and for at least one fillet weld of "Tee" joints and lap joints. In all welding, the application of the first pass shall be given special attention to insure satisfactory penetration and fusion of the filler and base metals. Preheating, root-chipping, and peening shall be utilized where directed to assure the soundness of highly important or heavily stressed connections and to relieve heavy residual stresses. Wherever practicable,

peening shall be done by pneumatic tools. Unless otherwise directed, the first and last beads of welded connections shall not be peened. The "housing" of welded connections by "returning" or "boxing" shall be employed as required, in accordance with approved welding practice.

(4) Assembling Devices and Temporary Connections. - Preparatory to welding, the assembled elements of members shall be held rigidly in position by the use of approved devices adapted to the purpose, and capable of exerting pressures requisite to remove local distortions and press the parts into intimate contact except where root openings are required. Bolts may be used for temporary connections provided that the bolt holes are subsequently filled in an approved manner, with sould weld metal and ground flush with adjacent base metal, unless otherwise authorized. Welding for temporary connections and bracing will be permitted provided that, where such welded connection does not form a part of a later permanent connection, such weld metal shall be removed, where so directed, approximately flush with adjacent base metal and in no case shall depressions be left in the finished work.

(5) Preheating. - Preheating shall be performed where specified or otherwise required. The weldments to be preheated shall be slowly and uniformly heated by approved means to the prescribed temperature, held at that temperature until the welding is completed and then permitted to cool slowly in still air.

(6) Welding of Steel Castings. - Castings shall be chipped, machined or ground to sound base metal at any surfaces which will be incorporated into welded connections. Major connections, designed for transfer of stresses, shall not be welded if the temperature of the casting is lower than 100 degrees F. Castings containing over 0.35 percent and up to 0.45 percent carbon or over 0.75 percent manganese, except Classes 1 and 2 (Fed. Spec. QQ-S-681b) shall be preheated to a temperature not to exceed 450 degrees F. and welding shall be accomplished while the castings are maintained at a temperature above 350 degrees F. Welding will not be permitted on castings containing carbon in excess of 0.45 percent, except on written authorization of the Contracting Officer.

26-04. FLAME CUTTING. - Flame cutting of material shall be subject to approval and where proposed shall be definitely indicated on shop drawings submitted to the Contracting Officer. Where a torch is mechanically guided, no chipping or grinding will be required except as necessary to remove slag and sharp edges. Where a torch is hand guided, all cuts shall be chipped, ground, or machined to sound metal except where material is not to be welded, in which case burrs and rough edges only shall be removed. Where the torch is mechanically guided, flame gouging will be permitted in preparation for welding.

26-05. BOLTED CONNECTIONS. - a. Bolt Holes. - Holes for unfinished bolts shall be not more than 1/16 inch larger than the nominal diameter

of the bolts. Unless otherwise specified or shown on the drawings, holes for turned bolts shall be not more than 0.020 inches larger than the nominal diameter of the bolt. Where the thickness of the material is greater than the nominal diameter of the bolt, holes for unfinished bolts shall be sub-punched and reamed or sub-drilled and reamed or drilled form the solid. Holes for turned bolts shall be truly cylindrical throughout and drilling or reaming shall be done after the parts to be connected are assembled. Poor matching of holes shall be cause for rejection.

b. Bolts and Nuts. - Bolts and nuts shall conform to the applicable provisions of Federal Specification FF-B-571a for "Bolts, Nuts, Studs; and Tap Rivets (and material for same)". Unfinished nuts and bolts shall be threaded to provide a Class 1 fit. Turned bolts shall have Type B-2 heads and Type A-2 nuts, Class 2 threads and the body diameter shall have a tolerance of plus 0.000 inches and minus 0.006 inches on the nominal diameter. The finished shank shall be long enough to provide full bearing, and washers shall be used under the nuts to provide full grip when the nuts are tightened.

c. Washers. - Plain washers shall conform to the requirements of ASA B27.2 - 1958 for "Plain Washers", heavy series and lock washers shall conform to the requirements of ASA B27.1 - 1958 for "Lock Washers", heavy series. Washers shall be provided for applications specified elsewhere and where indicated on the drawings.

d. Special Bolted Connections. - Where turned bolts with closer fits than specified above are required, the bolts shall have a nominal body diameter at least 1/16 inch larger than the nominal diameter of the threaded portion and the body length shall be 1/16 to 1/8 inch greater than the combined thickness of the connected members unless otherwise indicated on the drawings. Threads shall be Class 3 fit. Holes shall be as specified or indicated on the drawings. Plain washers shall be provided.

e. High-Strength Bolting. - High-strength bolting shall conform to the AISC Specification forStructural Joints using ASTM A325 Bolts.

26-06. MACHINE WORK. -a. General. - Unless otherwise shown on the shop drawings, all tolerances, allowances and gages for metal fits shall conform to ASA Standard B4.1-1955, "Preferred Limits and Fits for Cylindrical Parts," for the class of fit as shown or otherwise required. In general, tolerances for machine-finished surfaces designated by non-decimal dimensions shall be within 1/64 inch. Sufficient machining stock shall be allowed on placing pads to insure true surfaces of solid material. Finished contact or bearing surfaces shall be true and exact to secure full contact. Journal surfaces shall be polished and all surfaces shall be finished with sufficient smoothness and accuracy to insure proper operation when assembled. Parts entering any machine shall be carefully and accurately machined and all like parts shall be interchangeable. All drilled holes for bolts shall be accurately located.

b. Finished Surfaces. - Where the type of surface is indicated on the drawings or specified herein, the finish shall be the corresponding type, as defined below. Where the type of finish is not indicated or specified, the finish shall be that type, as defined below, which is most suitable for the part to which it applies and shall be consistent with the class fit required. Surfaces to be machine finished shall be indicated on the shop drawings by symbols which will show the type of finish to be provided.

(1) For a "rough" finish, pronounced tool marks will be allowed on the surface and slight depressions not affecting the strength or utility of the part will not be cause for rejection. The surface may be produced by rough planing, turning, grinding, sawing, machine-guided flame cutting or similar operations. In general, a "rough" finish will be required on surfaces which are to be machined to dimension where liberal tolerances will be permitted.

(2) For an "average" finish, a surface true to dimensions will be required; such as may be produced by medium smooth planing, turning, sawing, grinding, or similar operations. Only minor tool marks will be permitted. In general, an "average" finish will be required for stationary mating surfaces where reasonably accurate positioning of the members or a moderately tight joint is desired.

(3) For a "smooth" finish, a surface practically free of tool marks will be required; such as may be produced by smooth planing, turning, milling, grinding, drilling, reaming, or similar methods of machining. Pronounced tool marks or other defects on such surfaces will be cause for rejection. In general, a "smooth" finish will be required on surfaces in sliding or rotating contact when motion is slow and loads are light.

(4) For a "fine" finish, the surface shall be machined to close dimensional tolerances by fine turning, boring, milling, reaming grinding, medium buffing, burnishing, or similar methods. In general, a "fine" finish will be required on surfaces in sliding or rotating contact when loads and speeds are moderate.

(5) For a "polish" finish, the member shall present a very smooth surface such as may be produced by very fine surface or cylindrical grinding, smooth buffing, coarse honing, coarse lapping, hand finishing with fine emery cloth or other comparable methods. In general, a "polish finish will be required on surfaces in sliding or rotating contact where loads are heavy or motion is rapid.

c. Unfinished Surfaces. - So far as practicable, all work shall be laid out to secure proper matching of adjoining unfinished surfaces.

Where there is a large discrepancy between adjoining unfinished surfaces, they shall be chipped and ground smooth, or machined, to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown on the drawings and shall be chipped or ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts may be filled in a manner approved by the Contracting Officer.

d. Keys and Keyways. - Keys and keyways shall conform to the requirements of ASA Standard B17.1-1943 for "Shafting and Stock Keys", unless otherwise specified or required.

e. Pin Holes. - Pin holes shall be bored true to gages, smooth and straight, and at right angles to the axis of the member. The boring shall be done after the member is securely fastened in position.

f. Gears. - Unless otherwise specified or shown on the drawings, all gears shall have standard involute teeth, machine cut from the solid rim. Standard cycloidal teeth may be substituted in lieu of involute teeth upon the approval of the Contracting Officer.

g. Shafting. - Unless otherwise specified or authorized, all shafting shall be turned or ground steel shafting conforming to the requirements of ASTM A 107-59T. Fillets shall be provided where changes in section occur. Cold-finished shafting conforming to the requirements of A 108-58T, may be used, where keyseating is the only machine work required.

h. Bearings. - Unless otherwise specified or shown on the drawings, bearings may be lined with babbitt or bronze. Where the bearing pressure is in excess of 200 pounds per square inch, they shall be lined with bronze. Unless otherwise required or authorized, pressures on lined bearings shall not exceed 1000 pounds per square inch of projected area. Anti-friction bearings of approved types and of sizes not less than those recommended by the bearing manufacturer for the duty may be permitted at the discretion of the Contracting Officer. All bearings shall be properly aligned and provided with a suitable means for lubrication. Anti-friction bearings shall be so installed as to provide for retention of the lubricant and to exclude dirt and grit.

i. Protection of Machined Surfaces. - (1) Machine-finished surfaces shall be thoroughly cleaned of foreign matter. Finished surfaces of large parts and other surfaces shall be protected with wooden pads or other suitable means. Unassembled pins and bolts shall be oiled and wrapped with moisture-resistant paper or protected by other approved means.

(2) Finished surfaces of ferrous metals to be in bolted contact shall be washed with a rust inhibitor and given one thin coat of white or blue lead and tung oil.

(3) Finished surfaces of ferrous metals which will be exposed after installation shall be painted as specified in Section PAINTING.

j. Lubrication. - The arrangement and details for lubrication are shown on the drawings or otherwise specified. Before erection or assembly, all bearing surfaces shall be thoroughly cleaned and lubricated with approved high grade oil. After assembly, all lubricating systems shall be filled with the lubricant specified.

26-07. METALLIC COATINGS. - a. Zinc Coatings. - Zinc coatings shall be applied in a manner and of a thickness and quality conforming to ASTM specification A123-59 for "Zinc (Hot-Galvanized) Coatings on Products Fabricated From Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strips."

b. Repair of Zinc Coatings. - All zinc coatings that have been damaged in handling or transporting or in welding, installing or bolting shall be repaired by the application of a thick paste made from galvanizing repair compound conforming to Federal Specification O-G-93 and water. Areas to be repaired shall be cleaned thoroughly, including removal of slag on welds, before the paste is applied. Surfaces to be coated with paste shall be heated with a torch so that all metallics in the paste will be melted when applied to the heated surface. Extreme care shall be taken to see that adjacent zinc-coated surfaces are not damaged by torch. Molten metal shall be spread uniformly over all surfaces to be coated and the excess metal wiped off.

26-08. CASTINGS AND FORGINGS. - a. General. - Each casting shall have the mark number cast upon it. Each casting shall have the heat number stamped or cast upon it. Each forging shall have the mark number stamped upon it. Dimensions of castings shown on the approved shop drawings will be the finish dimensions.

b. Castings. - Repairs to castings shall not be made without the knowledge and prior approval of the Contracting Officer. Where repair welding is permitted, it shall be performed in accordance with the requirements of paragraph 26-03e(6). Warped or otherwise distorted castings or castings that are oversize to such an extent as will interfere with proper fit with other parts of the machinery will be rejected. The structure of the metal in the castings shall be homogeneous and free from excessive nonmetallic inclusions. Excessive segregation of impurities or alloys at critical points in a casting will be cause for its rejection.

26-09. PATTERNS. - a. Cast Iron and Non-Ferrous Metals. - In the construction of patterns care shall be taken to avoid sharp corners or abrupt changes in cross section, and ample fillets shall be used. The contractor shall add such draft and increased in pattern thicknesses as

will conform to his standard foundry practice and as may be necessary to insure that all metal thicknesses of the finished castings will be in accordance with the dimensions shown on the drawings within the tolerances specified in paragraph 26-08. All patterns will remain the property of the contractor. The contractor shall retain all patterns until the installation is completed and accepted.

b. Patterns for Cast Steel. - Patterns for steel castings shall be designed to minimize shrinkage damage and the design shall follow as closely as practicable the rules for steel casting design in "Steel Casting Handbook" published by SFSA. Pattern draft shall conform to the manufacturer's shop practice and shall be in addition to the given dimensions. Bosses for bolt holes may be omitted where adequate spot facing can be employed. Sufficient allowance for shrinkage and machining shall be added to the pattern so that the required finished dimensions can be held. All patterns will remain the property of the contractor.

26-10. LISTS OF MATERIALS. - The contractor shall furnish the Contracting Officer with six copies of all purchase orders, mill orders, shop orders for materials, and work orders, including all orders placed or extended by each supplier. Where mill tests are required, the purchase orders shall contain the test site address and the name of the testing agency. The contractor shall also furnish a shipping bill or memorandum of each shipment of finished pieces or members to the project site, giving the designation mark and weight of each piece, the number of pieces, the total weight, and if shipped by rail in carload lots, the car initial and number. Copies of certified shipping bills, in duplicate, shall be mailed promptly to the Contracting Officer.

26-11. SHOP ASSEMBLY. - Unless otherwise specified each machinery and structural unit furnished, except vehicular street gates, shall be assembled in the shop to determine the correctness of the fabrication and matching of the component parts. The tolerances shall not exceed those shown on the drawings and each unit assembled shall be closely checked to insure that all necessary clearances have been provided and that binding does not occur in any moving part. Assembly and disassembly work shall be performed in the presence of a Government inspector, unless waived in writing by the Contracting Officer, and any errors or defects disclosed shall be immediately remedied by the contractor, without cost to the Government. Before disassembly for shipment, each piece of a machine or structure shall be match-marked to facilitate erection in the field. The location of match-marks shall be indicated by circling with a ring of white paint after the shop coat of paint has been applied, or as otherwise directed.

26-12. FIELD ASSEMBLY. - a. General. - All parts to be installed shall be cleaned thoroughly; all packing compounds, rust, dirt, grit and other foreign matter removed; all holes and grooves for lubrication cleaned; and all enclosed chambers or passages examined to make sure

that they are free from injurious materials. Where units or items are shipped as assemblies they will be inspected by a representative of the Contracting Officer prior to installation. Disassembly, cleaning and lubrication will not be required except where there is indication that such work is necessary to place the assembly in a clean and properly lubricated condition. The top of all steel floor plating shall be installed flush with abutting curb surfaces. Stillson wrenches, cold chisels, or other tools likely to cause injury to the surfaces of rods, nuts, or other parts shall not be used for the work of assembling and tightening parts. Bolts and screws shall be tightened firmly and uniformly, but care shall be taken not to overstress the threads by using excessive force or wrenches of excessive length. When a half nut is used for the purpose of locking a full nut the former shall be placed first and followed by the latter. Threads of all bolts, nuts, and screws shall be lubricated by graphite and oil before assembly. Driving and drifting bolts or keys will not be permitted.

b. Alignment and Setting. - Each machinery or structural unit shall be accurately aligned by the use of steel shims, or other approved methods, so that no binding in any moving parts or distortion of any members occurs before it is finally fastened in place. The alignment of all parts with respect to each other shall be true within the respective tolerances required. The machines shall be set true to the elevations shown on the drawings.

c. Blocking and Wedges. - All blocking and wedges used for the support, during installation, of parts to be grouted in shall be removed before final grouting, unless otherwise directed by the Contracting Officer. Blocking and wedges left in the foundation with the approval of the Contracting Officer shall be of steel or iron.

d. Foundations and Grouting. - Concreting of sub-bases and frames and the final grouting under parts of machines shall be in accordance with the procedures as specified in Section CONCRETE.

26-13. TESTS AND TRIALS. - a. General. - The contractor shall at his expense, perform analyses and tests to demonstrate that all materials are in conformity with the specifications, except where such tests are waived in writing by the Contracting Officer. Should the contractor desire to use stock materials, not manufactured specifically for the work covered by these specifications, he shall submit evidence satisfactory to the Contracting Officer that such material conforms to the requirements of the specifications and detail tests of these materials will not be required, if so approved by the Contracting Officer. Tests, except where modified, shall be made as indicated in the respective detailed specifications or on the drawings and, unless otherwise authorized, in the presence of the Contracting Officer. The contractor shall furnish the

the Contracting Officer certified reports in triplicate of all required analyses and tests. The contractor shall furnish to the Contracting Officer, upon request, specimens and samples for independent analysis and test, all properly labeled and prepared for shipment.

b. Analysis of Material. - The contractor shall furnish the Contracting Officer certificates listing the heat numbers and the chemical and physical properties of the metal from which each article or piece of material was made. There shall be furnished also, two lists; one from the shop showing what pieces or members are to be made from the material ordered, and the other from the mills showing what pieces or members are furnished from each heat or melt.

c. X-ray and Gamma-ray Tests. - When doubt exists as to the soundness of any part, such part may be subjected to an X-ray or Gamma-ray inspection at the discretion of the Contracting Officer, and the cost of such inspection will be borne by the Government.

26-14. PAYMENT. - No separate payment will be made for the work specified in this section and all costs in connection therewith shall be included in the applicable contract price.

SECTION 27

PAINTING
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SECTION 27

PAINTING

27-01. GENERAL. - a. Scope. - (1) The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations in connection with preparation of surfaces, application of all paint or other materials and the manufacture of paints, paint materials and miscellaneous materials incidental thereto, (except as otherwise stated) complete, in strict accordance with the specifications and the applicable drawings, and subject to the terms and conditions of the contract.

(2) Surfaces to be painted shall receive the treatment and number of coats prescribed in the painting schedule.

b. Requirements. - No paint under this section will be applied to the following materials:

(1) Metal surfaces that are to be encased or embedded in concrete or masonry.

(2) Galvanized iron or steel (except as otherwise specified).

(3) Aluminum.

(4) Concrete surfaces.

(5) Factory-finished items.

(6) Corrosion-resisting steel.

(7) Items included to be painted under other sections.

(8) Scale-resisting gray iron alloy castings.

c. Definitions and Nomenclature. - (1) Paint. - The term "paint" as used herein includes emulsions, enamels, paints, stains, varnishes, sealers, and other coatings, organic or inorganic, whether they be used as prime, intermediate, or finish coats. This definition does not include troweled or metal-sprayed coatings.

(2) Shop Painting. - The term "shop painting", as referred to herein and/or on the drawings, covers operations conducted on painting material or equipment in a shop or plant before shipment to the site of erection or installation.

(3) Field Painting. - The term "field painting", as referred to herein and/or on the drawings, covers the application of paint coats at the construction site.

(4) New surfaces refers to unpainted surfaces of newly fabricated structures and items which are to receive paint coats.

(5) Touch-up painting refers to the application of paint on small areas of painted surfaces to repair mars and scratches and to restore the coating to an unbroken condition.

(6) Repainting designates the cleaning and recoating of extensive areas on which the existing coatings have deteriorated or otherwise do not provide adequate surface protection.

(7) Blast cleaning designates the cleaning of surfaces by forceful impingement of abrasive particles thereon by air blast or centrifugal action and includes sandblasting and gritblasting.

d. Standard Specifications. - Materials specified herein to meet the requirements of standard specifications published by national authorities shall conform with the issue in effect on the date of invitation for bids. National authorities publishing standard specifications referred to herein with the abbreviations used are as follows:

Agency	Abbreviation
Office of Standardization, Dept. of Defense	MIL or JAN
General Service Administration	Fed. Spec.
American Society for Testing Materials	ASTM Spec.
American Waterworks Association	AWWA Spec.

e. Samples and Tests. - One-quart samples of each batch of each type and color of paint proposed for use shall be submitted to the Contracting Officer and approval thereof received before the material represented by the sample is used on the project. In addition to furnishing samples, the contractor shall submit certified reports of tests thereof to the Contracting Officer, indicating compliance with the specifications.

f. Payment. - Payment for all work performed and for all materials furnished under this section of the specifications will be included in the contract prices for the items on which the work is performed, and to which the materials are applied.

27-02. CLEANING AND PREPARATION OF SURFACES. - a. General. - Surfaces to be painted shall be clean before applying paint or surface treatments. The removal of oil and grease shall, in general, be accomplished

with mineral spirits or other low-toxicity solvents having a flash point above 100°F. before mechanical cleaning is started. Solvent cleaning shall be done with clean cloths and clean fluids to avoid leaving a thin film of greasy residue on the surfaces being cleaned. Where blast cleaning is used, minor amounts of grease and oil contaminants need not be removed with solvents provided the abrasive is not reclaimed and reused and provided the blast cleaning process, by itself, leaves the surfaces completely free of grease and oil. Cleaning and painting shall be so programmed that dust or other contaminants from the cleaning process do not fall on wet, newly painted surfaces. Surfaces not intended to be painted shall be suitably protected from the effects of cleaning and painting operations. Fabricated, assembled items which are normally cleaned and painted in the shop in accordance with the manufacturer's standard practice will be considered for exemption from the detailed cleaning and painting requirements set forth herein, upon specific request of the contractor. Machine-finished and other bare metal surfaces, which are not to be painted, but which will require temporary protection during construction, shall be treated with rust-preventive compound conforming to MIL Spec MIL-C-16173B, Grade I, unless otherwise specifically indicated. Removable equipment adjacent to surfaces to be painted shall, if necessary, be disconnected and moved to permit cleaning and painting of said surfaces, and replaced by workmen skilled in the trades involved.

b. Cleaning and Preparation of Ferrous Surfaces. - (1) Surfaces in Exterior or Interior Atmospheric Exposure. - Ferrous surfaces which will be completely and continuously in normal exterior or interior atmospheric exposure (see schedule) shall be cleaned in the shop or place of manufacture. Grease, dirt, and other soiling substances shall be removed by means of emulsions, steam, solvents, and/or other approved methods. Rust and loose mill scale shall be removed by high speed-power brushing, scraping, chipping, disc-sanding or other approved means. Preparation of surfaces by blasting to at least the degree of surface cleanliness indicated for the other methods of mechanical cleaning may be used at the option of the contractor. The use of chipping tools with action so severe as to produce cuts, burrs and other forms of excessive surface roughness will not be permitted. "Tight" mill scale, i.e., that which cannot be lifted by applying a sharp knife to any edge, will be permitted. Minor amounts of residual rust, not removable except by thorough blast cleaning, will be permitted but stratified rust (scale) shall be removed in any event. Welds and adjacent surfaces to the extent affected by welding shall be given special treatment by scraping, chipping and wire-brushing to insure that flux, slag and weld spatter are removed. Following mechanical cleaning, the weld and adjacent surfaces shall be treated with a phosphoric acid solution conforming to Military Specification MIL-M-10578B, Type II, diluted in the proportion of 1 volume of base material to 4 parts of clean water. The diluted material shall be applied by brush or sponge and allowed to remain one-half minute or longer, followed by thorough wiping with clean wet rags. Surfaces shall be primed

in the shop as soon as practicable after cleaning with the linseed oil type primer specified for atmospheric exposed steel. (See schedule). Weathering of fabricated, unpainted steel for any purpose will not be permitted unless the surfaces are subsequently to be blast cleaned of all mill scale and rust to base metal. Prior to applying subsequent coats, all welds and other damaged areas of shop-primed surfaces shall be field cleaned and reprimed as previously specified.

(2) Cleaning and Pretreatment of Ferrous Surfaces in Underwater Exposure. - Surfaces of structural components which will be subject to extended periods of immersion or otherwise as required (see schedule) shall be cleaned of all rust, mill scale and other foreign matter to base metal by dry blast cleaning. Blast cleaning shall be done in the field after erection unless specifically authorized otherwise by the Contracting Officer. Surfaces to be coated which will not be accessible after erection shall be cleaned and painted before becoming inaccessible. The cleaned surfaces shall be of a uniform gray-white metallic color, completely free of mill scale, rust, oxide, paint, welding slag, weld spatter or other foreign material. Where necessary, power tools shall be used in conjunction with blast cleaning to effect the removal of weld spatter and heavy, stratified rust scale. Blast cleaning shall be accomplished with sand, crushed iron or steel grit or synthetic nonmetallic grit of such particle shape, hardness and gradation as to effectively clean the metal and leave a roughened surface suitable for tenacious adhesion of subsequent coatings. The maximum particle size of any type of abrasive shall be no larger than that passing a No. 16 mesh screen, U. S. sieve series. Nonmetallic abrasives shall be dustfree and no more than 10% shall pass a No. 50 mesh sieve. The contractor shall take all precautions to prevent damage to machinery and surfaces not requiring blast cleaning and to prevent dust from settling into any adjacent films of wet paint. As soon after cleaning as practicable and prior to the formation of any detectable condensation or corrosion, all blast-cleaned ferrous surfaces shall be cleaned of dust and abrasive particles by brushing, vacuum and/or blow-down with clean, dry compressed air, and given the first coat of paint including any pretreatment, required by the schedule. In no event, shall blast-cleaned surfaces stand overnight without having received the specified pretreatment and/or the first coat of paint prescribed by the schedule. Structural features or components which make up a single integral surface and which are subject in part to atmospheric exposure and in part to immersion in water, shall be prepared and painted as though the entire component were subject to immersion. Surfaces requiring complete removal of mill scale shall be cleaned in the field, except that upon written request by the contractor, the Contracting Officer may authorize mill or shop cleaning of assembled or partially assembled components specified to receive a vinyl type paint system. The surfaces, if shop-cleaned, shall be blasted, pretreated if required, and coated with the paint specified in the schedule for the first coat. The dry film thickness of the shop-applied coating shall be

2.0 to 2.5 mils, irrespective of the number of passes or coats required to achieve this thickness. This pre-erection or construction period coating shall be maintained in good condition by recleaning and touching up any areas damaged during the construction period. Prior to field application of subsequent coats to obtain the prescribed total film thickness, soiled areas of the pre-erection coating shall be thoroughly cleaned with mineral spirits and all welds or other unpainted or damaged areas shall be cleaned and primed in such a manner as to make them equivalent to adjacent, undamaged paint surfaces.

c. Cleaning of Galvanized Surfaces. - Unless otherwise specifically provided, galvanized surfaces shall not be painted. Where such surfaces are specified to be painted, they shall be first washed with clean mineral spirits and then coated by spray, swab or brush with vinyl type wash coat conforming to MIL Spec. MIL-C-15328B (see specific directions for application of vinyl type coatings) preparatory to receiving the specified paint coats.

27-03. PAINT APPLICATION. - a. General. - All work shall be done in a workmanlike manner, so that the finished coating will be free from holidays, pinholes, bubbles, runs, drops, ridges, waves, laps, unnecessary brush marks and variations in color, texture and gloss. All coats shall be applied in such manner as to produce an even film of uniform thickness. Edges, corners, crevices, seams, joints, welds, rivets and other surface irregularities shall receive special attention to insure that they receive an adequate thickness of paint. Care shall be exercised during spraying to hold the nozzle perpendicular to and sufficiently close to the surfaces being painted to avoid loss of material into the air, or the bridging over of crevices and corners. Spray equipment shall be equipped with traps, separators, mechanical agitators, pressure gages and pressure regulators. Aircaps, nozzles and needles shall be as recommended by the spray equipment manufacturer for the material being applied. Spray painting shall be supplemented by brushing or other means where necessary to properly coat crevices, pockets, interior angles and all other surfaces which cannot be satisfactorily coated by spray. Respirators shall be worn by all persons engaged or assisting in spray painting.

b. Paint Properties, Labeling, Storage, Mixing and Thinning. - All paint, when applied, shall provide a satisfactory film and a smooth, even surface. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints shall be thoroughly stirred, strained and kept at a uniform consistency during application. Paste pigments, specified to be added at the time of use, shall be mixed as follows: place the pigment in a separate container and add small increments of the required vehicle or base paint, with thorough stirring, until a viscous, smooth, homogeneous, lump-free mixture is obtained. Mix in the remainder of the vehicle or base paint by boxing and stirring. Powdered metallic pigments, added at the time of use, shall be mixed

by adding the powder in small increments to about one-third of the required base paint or vehicle, with thorough mixing to obtain a smooth mixture. The remainder of the vehicle or base paint shall then be thoroughly stirred in. Where necessary, in the opinion of the inspector, to suit conditions or surface, temperature, weather and method of application, the packaged paint may be thinned immediately prior to use by the addition of not more than one pint per gallon of the proper thinner; provided that in no case shall the paint be reduced more than is absolutely necessary to obtain the proper application characteristics. Vinyl paints may be thinned more than the maximum indicated above (see specific directions for applying vinyl type paints). Thinners shall not be added to cold applied coal tar paints unless recommended by the manufacturer. Paint shall be delivered to the job in unbroken containers which shall show the designated name, formula or specification number, color, batch number, any special directions, manufacturer and date of manufacture, all of which shall be plainly legible at the time of use. Paints which can be harmed by exposure to cold weather shall be stored in heated shelters. During application, the paint in the spray tank or other working container shall be not less than 50° F.

c. Atmospheric Conditions. - Except as specified or required for certain water-thinned paints, paints shall be applied only to surfaces which are completely free of moisture as determined by sight or touch. In no case shall any paint be applied to surfaces upon which there is visible frost or ice. While painting is being done, the temperature of the surfaces to be painted and of atmosphere in contact therewith, shall be maintained at or above 45° F., except that in no event shall latex type (water-thinned) paints be applied at air and surface temperatures which are low enough to detrimentally affect the formation and character of the dried film. Where paints are being used which dry solely by evaporation of organic solvent, such as the vinyl type paints, the temperature of air and surface may be 35° F., or as approved by the Contracting Officer. During periods of inclement weather, painting may be continued by inclosing the surfaces with temporary shelters and applying artificial heat, provided the minimum air, surface and paint temperatures prescribed above are maintained. Paint shall not be applied to surfaces which are hot enough to cause blistering or pinholing of the film.

d. Protection of Paint Surfaces. - Where shelter and/or heat are provided for paint surfaces during inclement weather such protective measures shall be maintained until the paint film has dried, and/or discontinuance of the measures is authorized. Items which have been painted shall not be handled, worked on or otherwise disturbed until the paint coat is completely dry and hard. After delivery at the site of permanent erection or installation, all shop-coated metalwork shall be stored out of contact with the ground in such a manner as will minimize the formation of water-holding pockets and in such a location as will minimize soiling, contamination and deterioration of the paint film. Shop-coated

metal shall be repainted or retouched from time to time with the specified paint, whenever in the opinion of the Contracting Officer it becomes necessary to maintain the integrity of the film.

e. Contacting Surfaces. - When riveted or bolted contact is to exist between surfaces of ferrous or other metal parts of substantially similar chemical composition, such surfaces will not be required to be painted. Contacting surfaces formed by high-strength bolt connections shall not be painted. Where an electrical potential is apt to exist between metal surfaces of unlike chemical composition in riveted or bolted contact, each of the contacting surfaces shall be cleaned, pretreated, and given one coat of primer, all as specified for the particular metals involved. Where a nonmetal surface is to be in riveted or bolted contact with a metal surface, the contacting surfaces of the metal shall be cleaned, pretreated if required, and given three coats of the specified primer.

f. Time between Surface Preparation and Painting. - Surfaces which have been cleaned and/or otherwise prepared for painting shall be primed as soon as practicable after such preparation has been completed, but in any event, prior to any deterioration of the prepared surface.

g. Method of Paint Application. - Unless otherwise specifically directed or authorized by the Contracting Officer, the first coat on surfaces of nonmetallic items shall be applied by brush or roller provided that the latter method, in the opinion of the Contracting Officer, furnishes a coating equal to brush application in appearance, uniformity and other respects. Subsequent coats may be applied by roller, spray or brush. The specified first coat of paint shall be applied by brush to ferrous surfaces which have not been blast-cleaned but may be applied by spray or brush, except as otherwise specified, to surfaces which have been blast-cleaned. All subsequent coats for all ferrous surfaces may, unless otherwise specified, be either brush or spray applied. All coats for nonferrous metal surfaces may be brushed or sprayed. Whenever spraying of a surface is permitted or directed, it is to be understood that all areas inaccessible to spray painting shall be coated by brushing or other suitable means.

h. Coating Progress. - Where field painting on any type of surface has commenced on any portion of the Work, the complete painting operation, including priming and finishing coats, on that portion of the work, shall be completed as soon as practicable, without prolonged delays. Sufficient time shall elapse between successive coats to permit them to dry properly for recoating and this minimum drying period shall be modified as necessary to suit adverse weather conditions. Paint shall be considered dry for recoating when it feels firm and does not deform or feel sticky under moderate pressure of the finger. The application of another coat of paint shall not cause such film irregularities as lifting or loss of adhesion of the undercoat and the undercoat shall have dried sufficiently

so as not to retard the drying of the next coat. At all times prior to final acceptance of the work, all coats of all painted surfaces shall be unscarred and completely integral at the time of application of all succeeding coats. At the time of application of each successive coat, undercoats shall be cleaned of dust, grease or any foreign matter, which might adversely affect intercoat adhesion, by means of air blast, solvent cleaning or other approved means. Field coats on metal shall be applied after erection except as otherwise specified and excepting surfaces to be painted which will become inaccessible after erection.

i. Drying Time Prior to Immersion. - Surfaces which have been painted with the cold applied coal tar system shall not be immersed in water until the final coat has dried at least 10 days.

j. Coverage and Film Thickness. - The actual surface area covered per gallon of paint shall not exceed the spreading rates prescribed in the schedule. Where no spreading rate is specified, the paint shall be applied at a rate normal for the type of material being used. In any event, the combined coats of a specified paint system shall completely hide the base surface. Where dry film thickness requirements are specified for ferrous surfaces, the measurements shall be made with a General Electric, Type B, film thickness gage, calibrated on metal identical in composition, thickness and surface preparation to the item being coated. Sufficient measurements shall be made to accurately establish average thicknesses.

k. Directions for Application of Vinyl Type Paints. - (1) Vinyl Type Wash Coat (conforming to MIL Spec MIL-C-15328B) shall be mixed by adding 1 volume of acid component (diluent) to 4 volumes of resin component (base solution). The acid component shall be added slowly and with constant stirring. After mixing, the wash coat shall be used within 8 hours and any mixed material older than 8 hours shall be disposed of or removed from the job. The wash coat shall be spray applied at a coverage rate of 250 to 300 square feet per gallon of resin component to give a dry film thickness of 0.3 to 0.5 mils. Small areas may be wash-coated by brush or swab. Care shall be exercised in spray application to avoid the deposition of dry particles on the surface. A wet spray shall be maintained at all times by additional thinning with Normal Butanol or 99 percent Isopropanol where required by prevailing weather conditions. The acid component (diluent), over and above the amount prescribed above shall not be used for thinning purposes. Surfaces treated with the wash coat shall receive the first coat of paint after at least one hour of drying for the wash coat, and within 24 hours after the wash coat treatment.

27-04. PAINTS TO BE APPLIED - NUMBER OF COATS AND FORMULAS. - a. General. - The surface preparation and paints required for various types of surface and exposure are shown in subparagraph b. below. Supplementary information for use with the schedule follows:

(1) Fabricated and Assembled Items which are normally painted in accordance with the manufacturer's standard practice except ferrous surfaces subject to immersion and abrasion in water may be exempted from the following schedule requirements for surface preparation and painting, on specific request by the contractor and approval by the Contracting Officer. Mars and scratches on surfaces painted in accordance with the manufacturer's standard practice shall be touched-up in the field to provide an appearance satisfactory to the Contracting Officer.

(2) Colors and Tints shall match the respective color specimens designated by, or shall otherwise be subject to the approval of the Contracting Officer. Where so directed by the Contracting Officer, alternate coats of paints having the same color shall be tinted with small amounts of ultramarine blue or lamp black or other approved ingredients, ground in a vehicle compatible with the paint being tinted, in order to insure that all surfaces are properly coated with the specified number of paint coats. Tinting of vinyl type paints shall be done only by the manufacturer. Unless otherwise specified, the color of undercoats shall match the color of the finish paint as nearly as practicable.

(3) The Method of Surface Preparation and pretreatment shown in the schedule is for identification purposes only. Cleaning and pretreatment of surfaces prior to painting shall be accomplished in accordance with detailed requirements hereinbefore described.

(4) The Designated Titles of Federal and other standard specifications, which are identified by symbol or abbreviated name elsewhere in this specification, are as follows:

Fed. Spec.	O-G-93	Galvanizing Repair Compound
	TT-A-468a	Aluminum-Pigment; Powder and Paste for Paint
	TT-P-343	Pigment, Carbon-black; Dry
	TT-E-489c	Enamel; Gloss, Synthetic (for exterior and interior surfaces)
	TT-P-61b	Paint; Ready-mixed, Black
	TT-P-81c	Paint; Ready-mixed, Exterior Medium Shades on a Lead-zinc Base
	TT-P-86a	Paint; Red-lead-base, Ready-mixed
	TT-P-102	Paint (Titanium-lead-zinc, and oil, exterior, ready-mixed, white and light tints)
	TT-P-641a	Primer, Paint; Zinc Dust-zinc Oxide (for galvanized surfaces)
	TT-T-291a	Thinner; Paint, Volatile Mineral Spirits (petroleum-spirits)
	TT-T-306	Thinner; Synthetic-enamel
	TT-V-119	Varnish; Spar, Phenolic-resin
Fed. Standard	141	Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling and Testing
	595	Colors

MIL Spec. MIL-M-10578B Metal Conditioner and Rust Remover (Phosphoric Acid Base)
MIL-C-15328B Coating, Pretreatment (Formula 117 for Metals)
MIL-C-16173B Corrosion Preventive, Solvent Cut-back, Cold-application
MIL-C-18480 Coating Compound, Bituminous, Solvent Coal Tar Base

(5) Special Formulations indicated in the schedule which are not covered by Federal or other nationally recognized standard specifications are shown in Paragraph 27-05.

b. Painting Schedule. - (1) Exterior Ferrous Surfaces Subject to Atmospheric Exposure.

Surface	Surface Preparation and Pretreatment	Paint Formulas to be Applied			
		1st Coat	2nd Coat	3rd Coat	4th Coat
Exterior ferrous surfaces subject only to normal atmospheric exposure, not otherwise specified	Solvent cleaning and wire brush (or equivalent); no pretreatment	Fed. Spec. TT-P-86a Type I	Fed. Spec. TT-E-489c Class A	Fed. Spec. TT-E-489c Class A	None
Vehicular Gates	Solvent cleaning and wire brush (or equivalent); no pretreatment	Fed. Spec. TT-P-86a Type I	P-9	P-9	None
Gate Hoist Stand	Solvent cleaning and wire brush (or equivalent); no pretreatment	Manufacturer's Standard	Fed. Spec. TT-E-489c Class A	Fed. Spec. TT-E-489c Class A	None
Pumping Station Doors and items specified in other sections to receive manufacturer's shop coat	Solvent cleaning and wire brush (or equivalent); no pretreatment	Manufacturer's Standard	Fed. Spec. TT-E-489c Class A	Fed. Spec. TT-E-489c Class A	None

Directions and Remarks: In the above system, the first coat shall be brush applied in the shop at a maximum spreading rate of 600 square feet per gallon and touched up as required in the field. The second and third coats shall be applied in the field at a maximum spreading rate of 500 square feet per gallon. Exterior ferrous surfaces shall include all ferrous metals within Pumping Station operating floor exposed to the atmosphere.

(2) Ferrous Surfaces Subject to Immersion, Protected from Abrasion and Sunlight.

Surface	Surface Preparation and Pretreatment	Paint Formulas to be Applied			
		1st Coat	2nd Coat	3rd Coat	4th Coat
Ferrous surfaces as follows: exposed structural steel and equipment below pump room floor in pumping station, except as otherwise specified, discharge piping and flap gates.	Blast clean only, and treat with Manufacturer's recommended metal conditioner	Cold applied coal tar base paint	Same as 1st	Same as 1st	None

Directions and Remarks: Materials shall conform to Military Specification MIL-C-18480 "Coating Compound, Bituminous, Solvent, Coal Tar Base". Apply heavily by brush or spray at a coverage of approximately 55-75 square feet per gallon to give a total film thickness of three coats of not less than 45 mils. Brush each additional coat perpendicular to strokes of preceding coat. Application details and drying time between coats shall be as recommended by manufacturer of coating.

(3) Exterior and Interior Galvanized Metal Surfaces

Surface	Surface Preparation and Pretreatment	Paint Formulas to be Applied			
		1st Coat	2nd Coat	3rd Coat	4th Coat
Exterior and interior galvanized metal surfaces, as follows:	Wash with solvents and apply Vinyl Type Wash Coat Mil Spec. MIL-C-15328B	TT-P-641b (Type II)	TT-E-489c (Class A)	TT-E-489c (Class A)	None

(a) All interior galvanized surfaces, Operating Floor, Pumping Station.
(b) All exterior galvanized surfaces, including pipe railing.

(4) Interior Ferrous Surfaces

Surface	Surface Preparation and Pretreatment	Paint Formulas to be Applied			
		1st Coat	2nd Coat	3rd Coat	4th Coat
Interior structural steel and other ferrous surfaces, except as otherwise specified	Solvent cleaning and wire brush (no pretreatment)	Fed.Spec. TT-P-86a (Type I)	Fed.Spec. TT-E-489c (Class A)	Fed.Spec. TT-E-489c (Class A)	None

Directions and Remarks: First coat shall be brush applied in the shop and its integrity maintained at all times by periodic touch-up painting in the field.

(5) Machinery, Interior and Exterior, Atmospheric Exposure.

Surface	Surface Preparation and Pretreatment	Paint Formulas to be Applied			
		1st Coat	2nd Coat	3rd Coat	4th Coat
Machinery in interior or exterior atmospheric exposure, except as otherwise specified	Solvent cleaning and wire brush	Fed.Spec. TT-P-86a (Type II)	Fed.Spec. TT-E-489c (Class A)	Fed.Spec. TT-E-489 (Class A)	None

Directions and Remarks: In lieu of the specified system, machinery may be coated in accordance with the manufacturer's standard practice, when specifically approved by the Contracting Officer. In either event, finish coats shall be of color as selected by the Contracting Officer. Machine-finished surfaces shall be protected during the construction period with rust preventive compound conforming to Mil Spec. MIL-C-16173A, Grade I, unless otherwise specifically indicated.

(6) Surfaces Subject to High Temperature. - Engine exhaust piping and mufflers shall be given one coat of "Bitumastic Hi-Heat Gray" as manufactured by Koppers Co., Inc., or approved equal. Application and workmanship shall conform to manufacturer's printed application data.

27-05. SPECIAL PAINT FORMULATIONS NOT COVERED BY STANDARD SPECIFICATIONS. - a. Exceptions. - The provisions and raw materials specified in this section are applicable only to the special paint formulations shown hereinafter in detail and not to those finished-product coatings governed by Federal or other standard specifications.

b. General. - Paints shall have the composition as indicated in the formulas listed herein. Except where otherwise specified or authorized, all paint shall be made by grinding together dry pigments and a liquid vehicle to form a smooth paint that will flow freely and will not settle or react deleteriously in containers. Where so specified, special pigments shall be packed in separate containers for mixing on the job. Unless otherwise specified, grinding shall produce a fineness such that coarse particles and skins will not exceed 1.5 percent (total residue left on No. 325 screen) based on pigment. All paints shall be so processed as to insure that within a period of one year from date of manufacture, they will not gel, liver or thicken deleteriously, or form gas in the closed container.

c. Inspection and Tests. - Inspection and tests, except as otherwise indicated, will be performed in accordance with the applicable provisions of the latest current revision of Federal Standard 141, entitled "Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling and Testing".

d. Packaging and Labeling. - Paints and vehicles shall be packaged in standard containers not larger than 5 gallons in size, with removable friction or lug-type covers. Containers for vinyl type paints shall be lined with a coating resistant to the solvents in the formulations and capable of effectively isolating the paint from contact with the metal in the container. Containers for phenolic aluminum paint shall be of the double-compartment type with the pigment compartment suspended inside the main container in such a manner that the pigment is isolated from contact with the vehicle. Each container shall be clearly and durably labeled to indicate the purchaser's order number, date of manufacture, manufacturer's batch number, quantity and full name and color of the material. Pigmented paints shall be packaged in containers not larger than 5 gallons.

e. Colors and Tints. - Colors where specified shall conform to the listed chip on latest revision of Federal Standard 595 "Colors". If not specified, the color shall be that naturally obtained from the required pigmentation.

f. Paint Formulations. - (1) Formula P-9; Aluminum Paint, Linseed-Tung Oil, Phenolic Varnish.

Ingredients	Gallons	Pounds	% by Wt.
Finish aluminum paste	14.1	172.0	21.0
Varnish (Fed. Spec. TT-V-119)	85.9	649.5	79.0
	100.0	821.5	100.0

Aluminum pigment shall be packaged separately for Formula P-9 and mixed with vehicle immediately prior to use. Each vehicle container shall be

labeled to the latter effect together with instructions showing correct proportions of vehicle and aluminum pigment. The mixed paint shall dry through, suitable for recoating, in 12 hours. Samples of Formula P-9 being submitted for approval shall include separate samples of aluminum pigment, varnish and the phenolic resin and oils used in the manufacture of the varnish.

g. Ingredient Materials. - (1) Aluminum powder shall conform to Federal Specification TT-A-468, "Aluminum-Pigment; Powder and Paste, for Paint", Type I, Class B.

(2) Aluminum paste shall conform to Federal Specification TT-A-468 for "Aluminum-Pigment; Powder and Paste, for Paint," Type II, Class B.

(3) Carbon black shall conform to Federal Specification TT-C-120 for "Carbon Black; Dry (Paint-Pigment)", Form I or II, Class B.

(4) Mineral spirits shall conform to Federal Specification TT-T-291, "Thinner; Paint Volatile Mineral Spirits (Petroleum Spirits)", Grade I.

(5) Thinner T-10 for Vinyl Coatings shall consist of 10 percent methyl isobutyl ketone (by weight) and 90 percent toluene.

SECTION 28

TOPSOILING, SEEDING AND MULCHING
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SECTION 28

TOPSOILING, SEEDING AND MULCHING

28-01. SCOPE. - This section covers topsoiling and seeding, complete.

28-02. MATERIALS. - a. Topsoil. - Topsoil shall be salvaged from areas within the limit of work in which excavation or grading is required. All other topsoil necessary to complete the work shall be furnished by the contractor from approved sources off the site at no additional cost to the Government. Topsoil to be provided by the contractor shall be natural fertile friable surface soil possessing the characteristics of representative soils in the vicinity that produce heavy growths of crops, grass, or other vegetation and shall be obtained from naturally well-drained areas. The topsoil shall be reasonably free from subsoil, clay lumps, brush, objectionable weeds and other litter. The topsoil shall be free from objects larger than 2 inches in any dimension, including stones, stumps, roots and debris, and shall not contain toxic substances or any other material or substance which might be harmful to plant growth or be a hindrance to grading, planting or maintenance operations. Delivery of off-site topsoil shall not begin prior to written approval from the Contracting Officer.

b. Fertilizer. - Fertilizer shall be complete 10-6-4 grade, and shall be uniform in composition, free flowing and suitable for application with approved equipment, delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable State Fertilizer laws, and bearing the name, trade name or trade mark, and warranty of the producer.

c. Lime. - Lime shall be ground limestone containing not less than 85 percent of total carbonates and shall be ground to such fineness that at least 50 percent will pass through a 100-mesh sieve and at least 90 percent will pass through a 20-mesh sieve. Coarser materials will be acceptable provided the specified rates of application are increased proportionately, on the basis of quantities passing the 100-mesh sieve, but no additional payment will be made for the increased quantity.

d. Seed. - All seed used shall be labeled in accordance with U. S. Department of Agriculture Rules and Regulations under the Federal Seed Act in effect on the date of Invitation for Bids. All seed shall be furnished in sealed standard containers, unless exception is granted in writing by the Contracting Officer. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable. The analysis of seed in each lot of mixture shall be as follows:

Kind of Seed (Botanical Name) (Common Name)	% by Wt. In Mixture	Min. % Purity	Min. % Germ.
Bromus inermis Smooth Brome	15	85	90
Agrostis tenuis hv Highland Bentgrass	5	98	85
Festuca elatior arundinaceae Alta Fescue	35	98	85
Festuca rubra Red Fescue	30	98	85
Poa compressa Canada Bluegrass	10	80	75
Trifolium repens White Clover (New York Wild Strain)	5	98	85

NOTE: Weed seed not to exceed 1.0% of total mixture.

e. Mulch. - (to be used only on slopes of 1 vertical on 3 horizontal or steeper.)

(1) General. - Acceptable mulch shall be any of the following materials, or other approved locally available material. Mulch material which contains an excessive quantity of mature seed of noxious weeds or other species which would grow and be detrimental to the desired turf, or provide a menace to surrounding farm land will not be acceptable. Straw or other mulch material that is fresh or excessively brittle, or that is in such an advanced stage of decomposition as to smother or retard growth of grass, will not be acceptable.

(a) Straw shall consist of the threshed stalks of oats, wheat, barley, rye, rice, flax, beans, peas or peanuts.

(b) Hay shall be cured, dried and shall be made up of native grasses, marsh or beach grasses or sedges.

28-03. INSPECTION AND TESTS. - a. Topsoil. - At least 30 days prior to the intended delivery of off-site topsoil, the contractor shall notify the Contracting Officer of the sources from which topsoil is to be furnished. The topsoil proposed for use will be inspected by the Contracting Officer to determine whether the selected soil or soils meet the requirements. At the time of inspection, the Contracting Officer will require representative soil samples to be taken from several locations on the area(s) under consideration to be tested for physical properties and pH (or lime requirement), for organic matter, and for available nitrogen, phosphoric acid and potash. Samples shall be supplied by the contractor at no additional cost to the Government,

and tests will be made under the supervision of the Contracting Officer without cost to the contractor. Sampling and testing will be in accordance with standard practices of soil testing. Topsoil shall be approved prior to use. Topsoil from off-site sources shall be required to contain not less than 5% nor more than 20% organic matter as determined by loss on ignition of the oven-dried samples, and shall contain a concentration of nutrients equal to that in any Government furnished topsoil. If, after the testing of the samples, the topsoil is found to be not in accordance with these specifications, the Contracting Officer may require as a requisite for acceptance, that the contractor, without additional compensation add humus as directed, to the topsoil proposed for use, in order to make the material acceptable, and that he add fertilizer as directed in addition to the quantity specified, to raise the concentration of nutrients to a level equal to that in the Government furnished topsoil, after fertilization. The depth to which topsoil is to be stripped shall be as approved, and samples drawn from the area shall be taken from the full stripping depth approved.

b. Fertilizer and Lime. -The Contracting Officer shall be furnished with duplicate copies of invoices for all fertilizer and lime used on the project. Invoices for fertilizer shall show the grade furnished. Invoices for lime shall show total minimum carbonates and minimum percentages of the material furnished that pass the 100- and the 20-mesh sieves. Each lot of fertilizer and lime shall be subject to sampling and testing at the discretion of the Contracting Officer. Sampling and testing will be in accordance with the official methods of the Association of Official Agricultural Chemists. Upon completion of the project, a final check of the total quantities of fertilizer and lime used will be made against the total area seeded, and, if the minimum rates of application have not been met, the Contracting Officer may require the distribution of additional quantities of these materials to make up the minimum application specified.

c. Seed. - The Contracting Officer shall be furnished with duplicate signed copies of a statement from the seed vendor, certifying that each container of seed delivered is fully labeled in accordance with the Federal Seed Act and is at least equal to the specification requirements for seed in the MATERIALS paragraph of this section of the specifications, as furnished with the purchase order. This certification shall appear on, or with, all copies of invoices for the seed. Each lot of seed shall be subject to sampling and testing at the discretion of the Contracting Officer. Sampling and testing will be in accordance with the latest Rules and Regulations under the Federal Seed Act.

d. Mulch. -No less than 30 days prior to commencement of mulching operations, the contractor shall notify the Contracting Officer of the sources from which the mulch materials are to be secured and the quantities thereof, and representative samples of the materials proposed to be used shall be furnished for approval.

e. Nomenclature. - The scientific and common names of seed materials specified herein conform with the latest approved names listed in "Standardized Plant Names" (1942 Edition) prepared by the American Joint Committee on Horticultural Nomenclature. Variety names not included therein are in conformance with names adopted by the U. S. Department of Agriculture and generally accepted in the seed trade.

28-04. AREAS TO BE TOPSOILED AND SEEDED. - The following areas shall be topsoiled, seeded, mulched, and otherwise treated as required by this section of the specifications:

a. Areas as indicated on the drawings.

b. Areas not indicated on the drawings but which fall within the meaning of GC-9. These areas shall be treated at no additional cost to the Government.

c. Areas falling outside the limits of work, areas within the limits of work where no work is indicated on the drawings, and areas used for the convenience of the contractor including haul roads, storage areas, access roads, field office sites, parking areas, stockpile areas and areas of similar use, unless specifically exempted in writing by the Contracting Officer. These areas shall be treated at no additional cost to the Government.

The provisions of this paragraph do not exempt the contractor from responsibility for vegetation other than grass, such as trees and shrubs, in accordance with GC-9 of these specifications.

28-05. PREPARATION OF SUBGRADE. - a. General. - Equipment necessary for the proper preparation of the ground surface and for handling and placing all materials required shall be on hand, in good condition, and shall be approved by the Contracting Officer before the work is started.

b. Clearing of Subgrade. - Prior to grading and tillage operations, all vegetation on the site sufficient to interfere with grading or tillage operations shall be mowed, grubbed, raked, and burned or removed from the site, or, when suitable, it shall be used for mulch as directed by the Contracting Officer. Prior to or during grading and tillage operations, the ground surface shall be cleared of all stumps, stones larger than 2 inches in diameter, roots, cable, wire, grade stakes, and any other materials which might hinder proper grading, tillage, or subsequent maintenance operations.

c. Grading of Subgrade. - Grades on the areas to be topsoiled which have been established by others, as shown on the drawings, shall be maintained in a true and even condition. Maintenance shall include necessary repairs to previously graded areas. Where the grades have not been established, the areas shall be graded to finish grade elevations

less the depth of topsoil to be applied, as shown on the drawings, and all surfaces shall be left at the prescribed grades in an even and properly compacted condition so as to prevent the formation of depressions where water will stand. The subgrade elevation at any point shall not vary more than plus or minus one tenth foot from finish grade elevations less the depth of topsoil, as shown on the drawings. Swales, ditches, slopes and level areas shall be accurately graded to required subgrade elevations.

d. Tillage of Subgrade. - After the areas required to be topsoiled have been brought to the proper subgrade parallel to the finished grades shown on the drawings, and immediately prior to dumping and spreading the topsoil, the subgrade shall be loosened by disking, or by scarifying to a depth of at least 2 inches, to permit bonding of the topsoil to the subgrade. On banks and inclines, the subgrade finish shall be loosened by harrowing in rows parallel to the contours of the slope. All other equipment to be employed on such slopes shall be operated similarly.

e. Approval of Subgrade. - There shall be no application of topsoil made without the prior approval of the finished subgrade by the Contracting Officer.

28-06. OBTAINING TOPSOIL. - After inspection and approval by the Contracting Officer of the source(s) of topsoil, and prior to stripping, rank growths of vegetation, stones, or debris on the surface which might interfere with grading or later tillage operations shall be removed. Sod or other cover that cannot be disked or otherwise incorporated into the topsoil before or after delivery, in such manner that it can be spread properly, shall be removed. Where topsoil is to be made available on areas to be graded, the topsoil shall be removed to the required depth from the designated areas prior to the beginning of grading operations. The topsoil removed from areas to be stripped or areas to be graded, or obtained from designated Government stockpiles, shall be kept separate from other excavated material. When topsoil is to be stripped and salvaged from wooded areas, or from areas where boulders, large stones or similar materials are present, clearing and grubbing shall be accomplished in accordance with the requirements of applicable sections of these specifications. Immediately following the clearing and grubbing operation, roots, stones, stumps and similar material shall be removed from the soil to the depth of topsoil salvage by means of a bulldozer equipped with a root-raking blade, by a tractor drawn stone rake, or by similar means. Topsoil from a wooded area shall not be salvaged, stockpiled or reused until it has been demonstrated to the Contracting Officer that removal of stones, stumps and other material having a dimension of 4 inches or over has been accomplished. All topsoil, regardless of the source, shall be transported and placed by the contractor. When topsoil is stockpiled for later use, the stockpiles shall be maintained free of weeds. Weed growth shall be prevented by the application of a suitable herbicide or by frequent cutting or pulling of plants.

28-07. PLACING TOPSOIL. - The topsoil shall be uniformly distributed on the designated areas and evenly spread, and in sufficient depth to compensate for any shrinkage, so that the thickness of the compacted topsoil shall be as provided by the drawings. The topsoil depth shall be measured perpendicular to the plane of the finished grade. The spreading shall be performed in such a manner that fine grading, fertilizing, liming and seeding can proceed with little additional soil preparation or tillage. Irregularities in the surface resulting from operations thereon shall be corrected to prevent the formation of depressions where water will stand. Topsoil shall not be placed or worked when it or the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to the proposed seeding or to proper grading. Topsoiling shall be performed only when it can be followed within a reasonable time by seeding.

28-08. PREPARATION OF SEEDBED. - a. General. - It shall be demonstrated to the Contracting Officer before starting work that the application of fertilizers, lime, and seed required will be made uniformly and at the specified rates.

b. Fine Grading. - The seedbed shall be brought to the required finished grades, free from unsightly variations, lumps, ridges, and depressions, thru successive stages of light rolling, fine grading, and hand and machine raking operations. Grades and elevations shall be properly set and marked by means of stakes, string lines, spot elevations and similar means when necessary or when required by the Contracting Officer. Rolling shall be accomplished with a roller weighing approximately 75 pounds per foot of width. During such operations and prior to seeding, the surface shall be cleared by whatever means are necessary including hand raking of all stones, stumps, or other objects larger than 1 inch in thickness or diameter, and of all roots, brush, wire, grade stakes, and other objects that may be a hindrance to maintenance operations. A finely pulverized seedbed shall be formed. The elevation of the seedbed surface at any point shall match exactly the elevation at adjacent pavement edges, curbs, manhole rims and finish grade elevation lines at structures, and overlot shall not vary more than plus or minus five one hundredths of a foot (.05 ft.) from the elevations shown on the drawing or interpolated from the contours, sections, or details.

c. Application of Fertilizer and Lime. - Fertilizer and lime shall be distributed uniformly over the areas specified to be topsoiled and seeded, in accordance with the following schedule:

Material	Rate In Pounds Per 1,000 S.F.
Fertilizer	25
Lime	100

Each material shall be incorporated independently into the top 3 inches of soil by disking, harrowing, drill, or other methods acceptable to the Contracting Officer during fine grading operations. Distribution of fertilizer and seed may be accomplished simultaneously by means of an approved seed drill equipped to sow seed and distribute fertilizer at the same time at the appropriate stage for seeding operations.

d. Leveling. - Any undulations or irregularities in the surface resulting from tillage, fertilizing, liming, or other operations shall be leveled out before seeding operations are begun. No seeding shall be done until the prepared seedbed has been approved by the Contracting Officer.

28-09. PLANTING SEED. - a. General. - All seeding work shall be done between the dates of 1 April and 15 June or between 20 August and 1 October, except as otherwise directed in writing by the Contracting Officer. A method of sowing satisfactory to the Contracting Officer shall be employed, making use of approved mechanical power-drawn drills or seeders, mechanical hand-seeders, or other approved methods. Regardless of the type of sowing equipment used, the seedbed shall be pulverized to a depth of three inches before seed is applied. When drills are used, provisions shall be made by markers or other means to assure that the successive seeded strips will overlap or be separated by a space no greater than the space between the rows planted by the equipment being used. When delays in operations carry the work beyond the most favorable planting season for the species designated, or when conditions are such, by reason of drought, high winds, excessive moisture, or other factors, that satisfactory results are not likely to be obtained, the Contracting Officer will stop the work, and work shall be resumed only when directed. If inspection, during seeding operations or after there is a show of green, indicates that strips wider than the space between the rows planted have been left, or other areas skipped or too sparsely seeded, the Contracting Officer may require corrective work and the sowing of additional seed on such areas. When the equipment used leaves wheel marks, tire marks, or ruts in the seedbed, such marks and ruts shall be removed by hand raking or the addition of topsoil and seeded.

b. Rates. - Seed shall be sown at the minimum rate of 3 pounds per 1,000 square feet.

c. Broadcast Seeding. - Seed shall be broadcast by approved sowing equipment. The seed shall be uniformly distributed over the designated areas. Half the seed shall be sown with the sower moving in one direction, and the remainder shall be sown with the sower moving at right angles to the first sowing. The seed shall be covered to an average depth of 1/4-inch by means of a brush harrow, chain harrow, cultipacker, or other approved device. Broadcast seeding shall not be done during windy weather.

d. Drill Seeding. - Drill seeding shall be done with approved equipment with drills not more than 2 inches apart. The seed shall be sown uniformly over the designated areas, and covered to an average depth of 1/4-inch concurrently with the sowing.

28-10. COMPACTING. - Immediately after the operations specified above have been completed, the entire area shall be compacted by means of a cultipacker, roller, or other approved equipment weighing 60 to 90 pounds per linear foot of roller. If the soil is of such type that a smooth or corrugated roller cannot be operated satisfactorily, a pneumatic roller (not wobble-wheel) will be required. The pneumatic roller shall have tires of sufficient size so that complete coverage of the soil surface is obtained. When a cultipacker or similar equipment is used, the final rolling shall be at right angles to the existing slopes to prevent water erosion or at right angles to the prevailing wind to prevent dust, as directed by the Contracting Officer.

28-11. APPLYING MULCH. - The mulch shall be spread uniformly on slopes of 1 on 3 or steeper in continuous blanket, as follows: Straw or hay at the rate of 2 tons per acre. If the mulching material is too long and brittle for proper securing in the surface soil, it shall be cut by an ensilage cutter or other equipment to lengths of not more than 8 inches and watered as needed before spreading, to assure proper securing of mulch into the soil as specified hereinafter. The mulch shall be spread by hand or by use of a manure spreader, a modified grain combine with straw-spreader attachment, a blower or other suitable approved equipment. Mulching shall be started at the upper part of a slope, and shall continue uniformly until the area is completely covered.

28-12. SECURING MULCH. - Immediately following the spreading of the mulch, the material shall be anchored to the soil by a V-type-wheel land-packer, a disk harrow set to cut only slightly, a rotary hoe run backwards, or other suitable approved equipment which will secure the mulch firmly in the ground to form a soil-binding mulch and prevent loss or bunching by wind. The number of passes over the mulch needed to secure it firmly to the soil shall be as determined by the Contracting Officer, but shall in no case exceed three passes. On slopes where machinery cannot be used, mulch shall be retained in place by a shallow covering of earth, by pressing into the soil at 18-inch intervals with a spade or other approved tool, by twine, stakes, or brush, or by other suitable means which will not be detrimental to subsequent maintenance.

28-13. REMOVAL OF MULCH. - Whenever in the opinion of the Contracting Officer the mulch material becomes injurious to the treated area because of decomposition, matting or bunching, or when growth of grass is retarded or maintenance impeded, the contractor shall carefully remove the mulch, transport it, and deposit it in an approved spoil area.

28-14. PROTECTION. - The topsoiled and seeded areas shall be protected against traffic or other use by erecting barricades or a substantial wire and stake enclosure immediately after seeding and mulching operations have been completed, and by placing warning signs of a type approved by the Contracting Officer on the completed areas. The contractor shall repair

any damage resulting from his operations. All mulch material which has been removed from the site by wind or from other causes shall be replaced and secured. Repair work which is required because of the contractor's negligence shall be performed without cost to the Government.

28-15. CLEAN-UP. - The contractor shall leave each area neat and clean, with adjacent turf and tree-covered areas raked of extraneous matter, and with all debris removed from the site. Any paved area over which hauling operations are conducted shall be kept clean and any topsoil, mulch, clippings, or other material which may be brought upon the paved surface shall be removed promptly.

28-16. ESTABLISHMENT. - a. General. - The contractor shall be responsible for the proper care of the seeded and mulched areas during the period when the grass is becoming established including watering. This period shall extend for 45 days after the completion of the seeding on the entire project except that when seeding is completed after 15 September, the maintenance period shall continue until 15 May of the succeeding year.

b. Watering. - All seeded areas shall be watered during the establishment period whenever considered necessary by the Contracting Officer. Seeded areas on which growth has started shall be watered to a minimum depth of 2 inches to assure continuing growth. Watering shall be done in a manner which will provide uniform coverage, prevent erosion due to application of excessive quantities over small areas, and prevent damage to the finished surface by the watering equipment. The contractor shall furnish sufficient watering equipment to apply one complete coverage to the seeded areas in a 12 hr. period.

c. Mowing. - The seeded areas shall be mowed with approved mowing equipment to a height of 2 inches when the average height of grass becomes 4 inches for initial mowing and 3 inches for all subsequent mowings. If weeds or other undesirable vegetation threatens to smother the planted species, such vegetation shall be mowed or, in the case of exceedingly rank growth, be uprooted, raked, and removed from the area.

d. Refertilizing and Reseeding. - Areas which, in the opinion of the Contracting Officer, fail to show a good growth of grass during the period of establishment cited above shall be tilled, refertilized, regraded and reseeded. Areas that require tilling, refertilization and reseeding will be designated by the Contracting Officer at least 15 days prior to the period specified for the next seeding season. The fertilizer shall be distributed on the areas to be reseeded during a period when the surface is dry. Reseeding shall be done in a manner that will cause a minimum of disturbance to the existing stand of grass. The fertilizer and seed shall be of the same grade, physical condition, packaging and marking, and shall be applied uniformly at the rates specified hereinbefore.

e. Herbicide Application. - The Contracting Officer may require the application of 2, 4-D herbicide during the maintenance period if, in his opinion, the amount of weedy vegetation present on the seeded areas so warrants, at no additional cost to the Government.

28-17. REPAIR. - When any portion of the surface becomes gullied, eroded, or otherwise damaged following seeding and mulching, or the seedlings have been winter-killed or otherwise destroyed through no fault of the contractor, the contractor shall, within 15 days of written notice by the Contracting Officer, restore the damaged portions to re-establish the condition of the finished grade prior to seeding. The area shall then be refertilized, reseeded and mulched as specified herein. An equitable adjustment will be made in the contract price, provided that the gullying, erosion, winter killing and other damage occurs after completion of all work required by this section of the specifications and the work done has been approved by the Contracting Officer.

28-18. COVER SEEDING. - When cover seeding is done, it will be accomplished without fine grading, fertilizer or liming operations. The seed shall consist of Hairy Vetch or Common Buckwheat, applied at the rate of 60 pounds per acre. When cover seeding is directed by the Contracting Officer, an equitable adjustment in the contract price will be made. When cover seeding is done by the contractor for his own convenience and the protection of his work, it shall be done at no additional cost to the Government.

28-19. ADDITIONAL MULCHING. - When required by the Contracting Officer, slopes less than 1 on 3 and flat areas shall be mulched as specified herein, and an equitable adjustment will be made in the contract price.

28-20. MEASUREMENT AND PAYMENT. - a. Topsoiling. Topsoil will be measured for payment on the basis of the number of cubic yards of topsoil acceptably placed or computed from the neat lines and grades indicated on the drawings or as stated in the field. Payment for topsoiling will be made at the contract unit price per cubic yard for Item "Topsoiling," which price shall include all cost of furnishing, segregation from excavations, loading, hauling, spreading topsoil, grading, tillage, and all labor, equipment, and incidentals necessary to complete the topsoiling.

b. Seeding. - Areas to be seeded will be measured as specified below for payment on the basis of the number of square yards measured. Measurement shall be made normal to and paralled to the slopes, and the actual area computed. Payment for such seeding will be made at the contract unit price per square yard for Item "Seeding," which price shall include all costs of finished grading, preparation of seedbed, application of fertilizer, lime and mulch, establishment, necessary repairs, and the furnishing of all labor, materials including seed, fertilizer, lime and mulch, equipment, and incidentals necessary to complete the seeding.

c. The payment for topsoiling or seeding does not include compensation for clearing and grubbing which is paid for in accordance with Section 1 or as subsidiary to borrow excavation. The payments for topsoiling or seeding does not include compensation for topsoiling or seeding for areas specified in Paragraphs 28-04b and 28-04c and all costs in connection therewith shall be considered as a subsidiary obligation of the contractor.

d. The quantities and types of lime, fertilizer and seed specified indicate anticipated average requirements. In the event changes are necessary in quantities or type of materials, a suitable adjustment to the contract will be made to cover the changes.

e. In the event repairs, as specified in Paragraph 28-17, are required due to no fault of the contractor, cover seeding, as specified in Paragraph 28-18, is directed, and additional mulching, as specified in Paragraph 28-19 is required, equitable adjustments will be made to the contract.